MUSLIM CONTRIBUTION
TO
GEOGRAPHY

BY

NAFIS AHMAD, M.A.

Professor of Geography, Islamia College, Calcutta
and
Post-graduate Lecturer, University of Calcutta.

MUHAMMAD ASHRAF

KASHMIRI BAZAR, LAHORE (INDIA)

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By the same Author

BASIS OF PAKISTAN

(Thacker Spink, Calcutta)

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To

MY PARENTS

PREFACE

While there have been many attempts to recognise and appreciate the extent and value of Muslim contributions to geography, the history of Muslim geographical thought is still to be written. The work of some Western Orientalists of the calibre of Reinaud, De Goje, Nallino, Sachau, Barthold, Le Strange, Kramers and Minorsky has greatly helped to unfold the many-sided contribution of Muslims to the general advancement of geographical thought and knowledge. But it is increasingly felt that scholars from Islam's cultural *milieu* would help towards a greater appreciation and evaluation of this glorious achievement and in the process avoid many a pitfall and overcome some of the cultural, linguistic and socio-religious difficulties which stand in the way of an 'alien' scholar, howsoever painstaking and sympathetic.

This small volume is offered as a modest contribution to studies directed to that end. Much of the ground covered is familiar to students of the subject. But my aim has been twofold. First, to illustrate the theme with the help of a large variety of contributions and secondly to evaluate the output spread over a period of more than six centuries, in a systematic form according to the practice and 'parlance' of modern geography.

I am fully conscious of my short-comings and handicaps and shall be grateful to receive helpful suggestions for the improvement of the present work But I venture to hope that this little book will supply,

however partially, the want of a general introduction to the vast subject of the Muslim contribution to geographical thought.

Naturally, my indebtedness to various writers of established fame both past and contemporary, through their works in English, French, German, Arabic, Persian and Urdu, is immense and as many as possible have been mentioned in the footnotes and the bibliography. In addition, I have been fortunate in enjoying the help and encouragement of many friends whose scholarship and advice I have been able to put to good account. In particular, I should mention my dear friend Dr. Syed Akhtar Imam (now Head of the Department of Arabic and Persian, Ceylon University) who suggested a closer study of the Muslim geographical literature in the light of my interest in the history of geographical thought, a subject which I had the opportunity of teaching to post-graduate students at the Muslim University, Aligarh, from 1936 to 1940. Among others I am thankful to Dr. Sh. Inayat Ullah, of Government College, Lahore, for offering many helpful suggestions, Mr. Jalal-ud-Din, of Islamia College, Calcutta, and Miss Indra Sarkar in giving invaluable assistance in translations from Arabic and French and German respectively; Professor Azizur Rahman Hashmi and Mr. Ruhul Quddus, of Islamia College, Calcutta, for assisting in the preparation of the Index, Major R. McConnel, Architect to the Government of Bengal, for designing the cover jacket and Mr. Abdul Karim, Cartographer in the Geological Survey of India, for lettering in the maps. I gratefully acknowledge the permission of the Editorial Boards of the *Islamic Culture*, Hyderabad, and the

Calcutta Geographical Review for making use of my earlier papers on the subject published in those journals. I must also thank the publisher, Shaikh Muhammad Ashraf for his enterprise in bringing out this book in spite of numerous immediate post-war handicaps.

Lastly, I must add a word of gratitude to my wife who helped at every stage in the writing of the book and later in the preparation of the Index. Her understanding and forbearance, above all, have made the completion of this work possible.

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CHAPTER I

GENERAL SURVEY

Muslim contribution to Geography has, generally speaking, been chiefly studied in the West,[1] both by orientalists and by some students of astronomy and mathematics. However, the chief deterrent to a greater appreciation and fuller recognition of the extent of Muslim share in advancing such scientific knowledge lies in the fact that, firstly, a large number of invaluable works referred to in extant sources have been entirely lost,[2] and many remain undiscovered, and secondly, much of the available material remains untranslated in the great European languages and the rest in many instances have not been properly approached and investigated. Nevertheless we are greatly indebted to some scholars, including those of the West, for their labours in presenting to the world the achievements of Muslim savants of yore.

Muslim contribution to the science of geography marks a definite stage in the history of geographical thought and knowledge. Its content was amazingly

1. Two Eastern contemporaries Prof. Aḥmad Zaki Validi of Turkey and Maulānā Syed Sulaimān Nadvi of Azamgarh have devoted painstaking attention to this subject. In Russia the late Prof. Barthold considered it a useful line of research and more recently Prof. Krachkovsky has written several chapters of his proposed work on Arabic geographers in spite of the booming of German guns all around Leningrad, during the period of siege by the Nazis.

2. Jurji Zaidān : *'Ulūm-al-'Arab*, pp. 236-37 estimates that of a total of about 6 million books in the various libraries of the eastern and western world of Islam, only about thirty thousand have survived the ravages of time.

vast and effects far-reaching. But a full appraisal of its importance can best be obtained in contrast to the state of ideas and knowledge in contemporary times as well as the period immediately preceding it.

The Greek and Roman contributions to geography reach their high watermark with the work of Cladius Ptolemy the Alexandrian, *i.e.* his 'Geography' and the 'Almagest'. Perhaps, it would not be too much to say that with him the story of ancient discovery comes to an end. From then onward, books in Greek and Latin cease to contain any more information and gradually the Dark Age of Geography set in, whic his characterised by a negation of the spirit of inquiry—a dominating feature of the early centuries of the Christian era. During this period the pagan Greeks and their intellectual attainment failed to excite the admiration of Christian savants. The influence of early Christian teaching was detrimental to the general acceptance of pre-Christian geographical theory. According to no less an authority than St. Ambrose to consider the nature and position of the earth would not help humanity in its hope of the life to come. In fact under the influence of Biblical outlook we find men denouncing the desire for investigation and curiosity for knowledge and science as vain and called such pursuit as magic art.[1] Thus naturally followed the maxim 'let God be true and every man a liar', while in spite of the intensely God-fearing attitude the Muslim savants' attitude was, 'Man knows this far but God knows best.' It is not surprising that the later belief

1. St. Augustine: *Confessions*, X, p. 35. See Kimble: *Geography During Middle Ages*, *op. cit.*, p. 150.

permitted man to gather as much knowledge as he could.

Geographical writers did not hesitate to make extraordinary assertions as the following: Mount Pelion is 250 miles from base to summit, the Alps are a modest 50 miles in height and that the whole world comprises two seas, 72 islands, 40 mountains and 65 countries, 281 towns, 55 rivers and 116 peoples.[1]

Isidore, in his 'Origins', is in utter confusion with his zones and circles as interchangeable terms. Thus the introduction of curious extravagances began to replace the so-called pagan views, the end of the world was freely anticipated in 1000 A.D. and the spherical shape of the earth and the existence of antipodes were favourite subjects of ridicule. A traveller Monk Cosmas Indicopleustes, for example, carried these ideas to their logical conclusion by entirely refuting the pre-Christian views about Cosmography (Astronomical Geography, as it was then called) in his famous work, 'Christian Topography'. His earth was flat, rectangular and oblong, twice as long from east to west as from north to south, and was surrounded by ocean. In addition, a high mountain rose in the north behind which the tiny sun played hide-and-seek to bring forth days and nights—and beyond the unknown vast oceans lay Paradise! Though Cosmas was certainly an 'extremist but others differed but slightly from him. Such conceptions about the earth remained the fundamental teachings of what has rightly been called the 'school of violent denial'. It is, in fact, against such a background that we are to judge the merit of the geographical work of

1. Dicuil: *De Mensura orbis Terrae*, VIII, pp. 26-31.

those early Muslims who rekindled the spirit of classical Greece and, what is of greater importance, carried it much further in enriching geographical thought.

The Arabs were indeed the heirs of that Hellenistic culture for which a way was first opened by the conquests of Alexander and which became so widely diffused throughout the eastern provinces of the later Roman Empire. It has been said that "Arabs are before all else the pupils of the Greeks; their science is a continuation of the Greek science, which it preserves, cultivates and on a number of important points develops and perfects".[1] Nobody can deny that this is precisely how the edifice of science and culture has been built up from the past to the present. As to the historical role of Islam's culture, Professor Aḥmad Zakî Validi rightly remarks,[2] "All events of world history are closely linked together: if the Islamic culture is unimaginable without the classical culture and the present cultural movement in the East unthinkable without the present European civilisation, similarly Franco-Germanic culture in the form which history shows us would never have come into existence without Islam." In the ultimate analysis we find that, speaking historically, the Greeks largely contributed to the culture of the mind and the beginning of science and the Romans were made for conquest and created vast dominions, while the Muslims took up both the tasks; on the one hand they established a great empire with its machinery of law and order and good government and on the other they built up the edifice of their culture upon the lessons drawn from the

1. Arnold and Guillaume: *The Legacy of Islam*, p. 376.
2. 'Islam and the Science of Geography,' *Islamic Culture*, Hyderabad, Vol. VIII, 1934, p. 511.

wisdom of India, Iran, Chaldea, Greece and Rome. On the culmination of the age of conquest the Muslims had become masters of many of those territories which had served in the past as the cradles of civilisation and culture—Mesopotamia, Persia and Egypt. The conquest of Syria and Palestine ;had early brought them into contact with the Nestorians who had become custodians of classical knowledge. This came at an opportune moment when conquest and expansion were giving place to peace and culture.

By the commencement of the Abbasid age the many-sided cultural influences produced the early phase of the real scientific age of Islamic culture. With the advent of Al-Mâmûn the weight of his personality and liberal patronage of learning was harnessed to the advancement of science along with that of all branches of learning. The great Translation Bureau, Baitul Ḥikmah, had already been established under Hârûn al-Rashîd, where were employed learned translators of all nationalities and creeds—Hindus, Parsis, Christians, Jews and Muslims.[1] Books and extant material were collected by Mâmûn from all countries regardless of cost, and translators were paid the weight of books in gold.[2] The liberality of this enlightened prince in the promotion of knowledge was remarkable indeed. He is said to have asked the Byzantine Emperor to send the savant Leo to Baghdâd in return for five tons of gold and an offer of permanent peace between the parties.[3]

1. Shibli : *Al-Māmūn*, p. 164. Also, Meyerhof : 'Transmission of Science to the Arabs,' *Islamic Culture*, Hyderabad, Vol. XI, 1937.

2. *Ibid.*, p. 170.

3. *Ibid.*, p. 175.

The Arab interest in matters geographical was largely born of the environment in which they lived. They had to have a knowledge of the fixed stars, the movements of the planets and other heavenly bodies and of the changes of weather. These were of interest and carefully observed for the purpose of travel over the vast expanses of the desert, whether for purposes of war or peaceful movement. Flocks and herds, the most precious possession of the dwellers of the desert, had to be moved from time to time in search of fresh and better pastures. The knowledge of plants and wild animals of the desert was obviously acquired on such wanderings. Much information of tribal history and the physical surroundings of such human groups was enshrined in poetry and eloquent speech, lore and rhetoric. No wonder then that before the birth of the scientific geography of the Arabs we find contributions which deal with matters geographical.

The majority of Arabic geographical authors looked upon Ptolemy's 'Almagest' (المجسطى) and 'Geography' with respect and many an admirer followed the tradition of the Alexandrian who had given a mathematical and astronomical bias to his labours.[1] Thus beginning was made with Muslim astronomical and mathematical geography. Though geographical matters had already attracted the attention of Arabic writers[2] who dealt with the geography, historiography and archæology of Arabia, *i.e.* Abû-Ziyâd al-Kilâbî, An-Naḍar b. Shamîl (d. 204 A.H.), Hishâm al-Kalbî (206 A.H.), Sa'dân b. al-Mubârak and Abû Sa'îd al-Asma'î (d. 213 A.H.). Aided

1. The first translation of the *Almagest* by Nairizi was of great consequence.
2. Maulānā Sulaimān Nadvi : *'Ilm al-Jughrāfia al-'Arab, 'aḍ-Diā*, Sept. 1932.

by their own native genius, by the keenest inter-regional competition—for their culture radiated from a number of centres, spread out from Andalus (Spain) to the confines of China—and the stimulus of the classical models they succeeded in advancing the cause of everv known science. With the spread of the wave of Islamic conquest the supremacy of the Arabic language over all other national languages came to be established, and, in addition, this homogeneity of the medium of expression and to a large extent of religious belief led to the growth of a common culture, in the midst of which grew up the learned of all nationalities and sects. Islam, to millions of people. was culture rather than religion and the Arabic language the language of science. Geography specially interested the Muslims because they had early felt the need for the accurate determination of position. For the 'children of the desert' astronomical knowledge was of great interest and had much utilitarian value. The relationship between that science and mathematics is close and the knowledge about the position of stars leads to the determination of latitude and longitude. Thus mathematical geography and cartography came in for early interest.

The expansion of political power and the establishment of a great brotherhood made the information about the lands of Islam one of ever-increasing interest. Here one should not forget the great impetus to inquisitiveness provided by the annual congregations of the Ḥaj at Mecca. To the Muslim it was not a matter of choice; it was his positive duty within the limits of possibility to undertake it. Thus ran to

Arabia a constant stream of visitors hailing from every nook and corner of Dâr al-Islâm (Islamic lands).

The Ḥaj thus remained a unique vacation, which gave an initiation into the great world of Islam, providing vast opportunities for an exchange of views and the narration of experiences in travelling, when thousands of Muslims of different races, coming from a variety of social and physical environment, met their co-religionists. It was for scholars, the exact equivalent of modern journeys abroad for studies. The years spent to and from Mecca and Medina with the slow pace of mediæval communications, were the 'Wander Jalre' of Muslim students young and old.

We find that the Arabic narratives of Muslim pilgrims are far superior to the Christian ones and their scientific value is much greater. 'Travels of Ibn Jubair' (رحلت ابن جبیر) 1183-85, guide book of Persian Al-Harawi (اشارات علی معرفتہ الذیارات) (d. 611-1214), Al-Abdarî's (Abû Muḥammad of Valencia), Accounts of journeys through North Africa (الرحلتہ المغربیہ) (688-1289) and Muḥammad Ibn Rushaid's account are outstanding examples of such geographical literature. The travellers were many-sided men who possessed a keen sense of observation and took pains to obtain information of various kinds and to meet famous scholars.

Through the organisation of the postal system (the barîd) and the development of routes and communications attendant on the establishment of a vast empire, incentive was provided for the appearance of many route books (Kitâb al-Masâlik wal Mamâlik). In this category come many famous geographical works bearing this title, *i.e.* Ibn Khurdâdhbih, Iṣṭakhrî, Ibn Ḥawqal.

We also come across many a men who spent years in travelling throughout the Islamic lands and some even visited far-flung no-Muslim regions and as a result of their experiences wrote remarkable travel accounts often embodying valuable geographical information. Most of such travellers visited the holy places but in many cases their pilgrimages were incidental. Ibn Ḥawqal, Mas'ûdî, Maqdisî, Idrîsî, Abu'l 'Abbâs al-Nabâtî (of Seville), Ibn al-Baiṭâr (of Malaga)—both botanical explorers and Ibn Baṭṭûṭa were great sojourners on land. Among sailors we have Sulaimân Tâjir (merchant) Buzurg Ibn Shahriyâr, Ibn al-Mâjid and Sulaimân al-Mahrî. They have left to us a geographical literature of far-reaching importance.

Another class of geographical writing consists of descriptions of specific regions in many details. Among earlier works of this kind may be pointed out the work of Khaṭib Baghdâdî, 1071 A.D. (sort of topographical study of Baghdâd). Among the later there are several worthy of our attention, *i.e.* Ibn al-Balkhî's description of Fârs (1110 A.D.) in Persian, Ibn Jamî's description of Alexandria and its climate and 'Abd al-Laṭif's description of Egypt. These constitute some of the most important topographical works of the Middle Ages.

Taking Muslim contributions to geography as a whole, a fourfold division can be made out for a convenient appraisal and study. (1) Descriptive geography, (2) Advancement of geographical conceptions and geographical interpretations, (3) Cartography, (4) Astronomical and mathematical geography.

Descriptive Geography

The development of Muslim descriptive geography can be taken note of in four distinct aspects and the relevant material is derived from contributions pertaining to these fields. (1) An extensive travel literature both by land and by sea. (2) The various itineraries, giving profuse details of routes, distances and stages. (3) Elaborate treatises on regional and local geography. (4) A mass of historico-topographical literature on single towns in various parts of the Islamic world—quite often providing much geographical information.

1. *Volga-Caspian, Northern Europe and Siberia*—Besides possessing the Greek and Roman knowledge of lands and seas the Arabs were better acquainted with four other regions hitherto only vaguely known.

Strabo's and Ptolemy's knowledge about the regions round the Caspian Sea and areas to the north-east of the Black Sea was very scanty. Pliny regarded the Scythians as cannibals while Ptolemy's Sea of Azov extended to the site of Moscow. The Sea of Aral was not mentioned at all. The Lake of K͟hwârizm (Aral) was represented for the first time on a map in Caliph Al-Mâmûn's times.

Many expeditions were sent in this direction from Bag͟hdâd. In 921 A.D. Ibn Faḍlân went as an envoy to the court of Volga Bulg͟hars and wrote the first reliable account of this area. He was one of the earliest traveller-geographers. Yaqût later on probably utilised this source in his great geographical Dictionary معجم البلدان. Another work of considerable importance by Ibn Faḍlân was his 'Risâlah' which was recently discovered by Prof.

Aḥmad Zakî Validî at Mas͟hhad. Among other authorities Al-Bîrûnî is the first to give the names of River Angara and of the populations of the Baikal region in Eastern Siberia. He also gave accounts of the Scandinavian Warangians, about the metal-work in Northern Europe and provided adequate information concerning the Ice-Sea north-east of Europe.[1] Later on, numerous Arab traders visited these parts and extended their activity particularly to South Russia and Poland. Scandinavian countries too did not escape their notice and the recent discovery of large number of Arab coins found in places as far north as Russia, Finland, Sweden and Germany, testify to the world-wide commercial activity of the Muslims of this and the later period.

2. *Africa and Adjoining Waters.*—The Greeks and Romans had frequented the East African coast and the former had founded some coastal settlements. But their activity at all periods was confined to the littoral portion and the tropical heart of Africa remained unknown to them. From these contacts Europe only inherited a legacy of fantastic fiction and the Roman " Africa " largely meant Mediterranean coastal regions and the bordering desert fringes and Egypt. Soon after the conquest of Egypt the Arabs penetrated into the Sahara and the zeal to spread Islam as well as the wings of commerce brought them into contact with the lands south of the vast desert. With the establishment of contact and friendly relations with the Sudan (1076) on the one hand they reached the Senegal and the Niger and on the other probed into

1. Prof. Aḥmad Zaki Validi : 'Islam and the Science of Geography'—*Islamic Culture*, Hyderabad, Vol. VIII, 1934, p. 513.

the secrets of the Upper Nile Valley. Many years passed, however, before the peoples of Christian Europe figured directly in this trade, partly from their anti-Muslim prejudice and partly because it was not within their power to enter the field in the face of Islam's domination. Along the east coast of Africa Muslims early claimed many maritime adventures and actually penetrated as far as the coast of modern Natal.

There are several notable geographical works on which the Arab knowledge of Africa was based. Among early sources was Muhallabî who was the author of an outstanding geographical work dealing with Sudan, which was written for the Fatimid Caliph Al-'Azîz in 375 A.H./985 A.D. It was the first book of its kind about this area and later formed Yâqût's main source for the geography of the Sudan. The great Al-Bîrûnî obtained personally valuable information about South Africa and Mozambique (his Safâlatu'z Zanj) from Muslim merchants. On the basis of such information he was not only able to remark "During our summer (there) winter prevails", but also could suggest that the southern sea (Indian Ocean) communicates with the ocean (Atlantic) through a gap in the mountains along the south coast (of Africa). He added, "One has certain proofs of this communication although no one has been able to confirm it by sight."[1] Later in mid-twelfth century Idrîsî through his geography 'Nuzhat al-Mushtâq fî Ikhtrâq al-Âfâq', provides information with indisputable accuracy about the Niger above Timbaktu and of the region of the head-waters of the

1. Sachau : *Al-Bīrūnī's India*, Vol. I, p. 270. Also Reinaud : *La Geographie d' Aboulfeda*, Vol. II, pp 14-15.

Nile and large tracts of Sudan. The modernity and high intrinsic worth of Idrîsî's information of Africa excites the admiration of modern geographers.[1]

3. *Chinese Border, Central Asia and South Asia.*—A study of pre-Muslim geographical literature reveals the very vague and scanty knowledge possessed by the West about the great interior of Asia. About South Asia including India the information of historians like Herodotus, the Greek and Roman geographers and merchants was equally meagre. Soon after the Muslim conquest of Transoxiana (Mâ wrâ al-Nahr) they rapidly pushed on to the vast Central Asian area buttressed on the east by the lofty peaks of the Chinese mountain ranges. In the earlier phase of Muslim geographical writing there appeared native geographers in Jaihânî (Minister at Samanid Court, 892-907 A.D.), Gardîzî, (the author of 'Zainul Akhbâr'), the author of 'Ḥudûd al-'Âlam,' 'Balkhî' and 'Al-Bîrûnî'; who added valuable information of this area. The Muslims began to play a leading part in the administration, commercial and cultural life of Central Asia and their knowledge is reflected in the historico-geographical works of this period. After the Tartar inundation had passed and once more life returned to normal states, it emerged enriched with Mongolian and Turkish contact. On the one hand noted travellers like Juwenî, Ibn Baṭṭûṭa and 'Abdur Razzâq went over the greater part of this area and have left many-sided and useful descriptions. Their accounts exceed those of Polos in value because these Muslim travellers, after all, sprang from the same cultural *milieu* as the vast population of these regions.

1. Kimble: *Geography in the Middle Ages*, p. 59.

Rashîduddîn, the Grand Vazir of the Mongols who had access to valuable sources of information, wrote his monumental 'Jâmi'at-Tawârîkh' (History of China, India and Europe) and the book of geography, 'Ṣuwaru'l Aqâlîm' (which remains undiscovered). Muslim geographers at the time of the Mongols had, therefore, an influence over the geographical science of the Chinese. Thus the Chinese official map for the year 1331, as Albert Hermann has pointed out, was composed either in dependence on Muslim geographers or by Muslim geographers themselves.[1]

Knowledge about India also, in spite of the epoch-making invasion of Alexander and some Roman commercial activity in the Indian Ocean waters, was scanty. Soon after the Muslim conquest of Sind and South-western Punjab, the Arab world began to get first-hand information of Hind (India). The traders and settlers along the Konkan and Malabar coasts through their friendly relations with native populations could observe things close at hand. Sulaiman Tâjir (merchant) 237 A.H./851 A.D. who travelled to India and China and Abû Zaid Sîrâfî who compiled his work a little later, in 'Silsilat-al-Tawârîkh,' provided some of the earliest information on Indian geography and social and economic conditions. Then we have the observations of great travellers like Ibn Ḥawqal and Mas'ûdî who speak at length about Makrân, Sind and the west coast. Geographers like Ibn Khurdâdhbih, Iṣṭakhrî and Maqdisî also treated India in many details. However, the Muslim geographers of this period only spoke of that part of India with which the Arab world was in direct

1. Prof. Aḥmad Zaki Validi: *Islamic Culture*, Hyderabad, Vol. VIII, 1934, p. 514.

contact, *i.e.* west of the geographical barriers of the Thar Desert and the Shishahdri Mountains (Western Ghats). Then came the Muslim advance into India through the passes of the north-west in the shape of the Ghaznivid penetration. The great scholar Al-Bîrûnî came to India, studied Sanskrit, Indian arts and sciences and produced his monumental 'Kitâbul Hind,' in many places giving a detailed geographical picture of the country. Idrîsî, Abu'l Fidâ and Ibn Baṭṭûṭâ later gave plentiful information about India, so that this land of spices, silver and gold and old culture did no longer remain mystery to the Mussalman world.[1]

The Muslim geographers made great strides forward in the sense that their works laid stress on the cultural side and sociological matter. The determination of latitudes and longitudes of numerous places and the data for lines of march and routes and stages is very explicit. To use a modern parallel, we cannot call them merely 'geographical geographers.'

It has often been said that the most fruitful and the classical age of Muslim geography passed away with the works compiled in the ninth and tenth centuries A.D. and the later writings were either mere repetitions or incoherent collections of information. But such a view is based chiefly on a lack of knowledge of many later works which till today remain untranslated into the great European languages. This is not to deny that in many works is found a mixture of fact and fiction. Therefore, as has been suggested by many students of the subject, it is necessary to analyse them critically.

1. See Nainar : *Arab's Knowledge of South India* (Introduction). Also Elliot : *History of India*, Vol. I, Chaps. I—IX.

In the writing of world history, unfortunately, quite often, clerical and narrow national and racial interests have been responsible for the fabrication of untrue stories and invention of 'facts' that would encourage the crusading enthusiasm of the masses in the past. Such an attitude has left a legacy that has buried the truth for centuries. Europe's share in this has been considerable. Today with the help of honest students of history and sympathetic orientalists much of this garbage is being removed.

Lastly, the study of the cultural history of the Islamic world should no longer be considered the special and narrow domain of philologists and orientalists, but as a subject of research and understanding of world culture by all students of the history of mankind. Thus among the sources that need be consulted the vast Muslim historico-geographical literature is indispensable.

In the following pages is provided the story of the many-sided contributions of Muslim geography.

CHAPTER II

THE GEOGRAPHERS

The earliest known Muslim writing dealing with geographical matters was that of Hishâm b. Muḥammad al-Kalbî (d. 820 A.D.) who is regarded as an excellent authority for the history of the pre-Islamic period. But only a few fragments[1] of his works have come down to us. He is said to have written ten books containing geographical topics. Though he was mainly a writer on Arabia, it is surmised that he had also dealt with other subjects.

The work of Muḥammad b. Mûsâ al-Khwârizmî laid the first foundations of Arabian geographical science. His 'Kitab Ṣûrat al-Arḍ' كتاب صورة الارض (Shape of the Earth) was written in the first half of the ninth century A.D. The exact date has not been fixed, but, according to Wiedmann. Khwârizmî took part in the scientific activity which flourished during the times of Caliph Al-Mâmûn (813-33 A.D.) and it is believed that his work is connected with the famous map of the world drawn by many scholars for the Caliph. Although Barthold has suggested that the work was probably compiled in the days of Mu'taṣim, the succeeding Caliph, as the new capital Samarra (Surra-man-ra'a) is mentioned by Khwârizmî. As to the merit of the work, Nallino[2]

1. Maulânâ S. Nadvi: *Arḍ al-Qur'ân*, Vol. I, p. 16, says that few fragments of Kalbi's works are available, while Kramers in *Encyclopaedia of Islam*, Suppl. says that none has come down to us. S. Nadvi calls him the author of *Kitâb al-Nawâdir*.

2. Minorsky: *Ḥudûd al-'Âlam*, (Barthold's Preface, p. x)

remarks that it is a work the like of which no European nation could have produced at the dawn of its scientific activity. In Khwârizmî's work is found along with geographical names of the Muslim period a great number of ancient names also.

The famous philosopher Al-Kindî (Abû Yûsuf Ya'qûb) was a younger contemporary of Khwârizmî and died 260 A.H. 873-4 A.D. He wrote a geographical work under the title of 'Description of the Inhabited Part of the Earth' (Rasm al-Ma'mûr min al-Arḍ). A pupil of Kindî, Sarakhsî (Aḥmad b. Muḥammad b. at-Ṭayyib) who died in 899 A.D. was the author of a book on 'Routes and Kingdoms' (Kitâb al-Masâlik wa'l Mamâlik). He also wrote on 'Seas, Waters and Mountains' (Risalah fi al-Baḥâr wa'l Miyah wa'l Jibâl). About the same time one of the leading mathematicians, Abu'l Ḥasan Thâbit b. Qurra' (836-901 A.D.) translated Ptolemy. But to Sarakhsî, who was a native of Khurâsân and worked at Baghdâd, goes the credit of producing a work which was more 'geographical' than astronomical and mathematical in outlook.

One of the earliest geographical works of this period is that of Ibn Khurdâdhbih (Abu'l Qâsim 'Ubaidullâh Ibn 'Abdullâh) who was descended from a Persian family and was brought up in Baghdâd, where he made the acquaintance of the celebrated musician, Ishâq of Mawsul. He also studied literature along with music. Later on he was appointed the chief postmaster of Jibal province and it seems utilised his official position to obtain much useful information about distant regions. Between the years 844 and 848 A.D. he was at Samarra

on the Tigris, and it was then that he wrote his famous 'Kitâb al-Masâlik w'al Mamâlik' (on Routes and Kingdoms) an outstanding work of its kind. It gives a summary of the main trade-routes of the Arab world and in addition gives descriptions of such distant areas as China, Korea and Japan. Though in several places facts are mixed with fiction and hearsay. Later geographers invariably consulted this work and it is surprising indeed that, unfortunately, only an abridged version of this book has been handed down to us.

A work of the same period is that of a Bedouin, Arrâm b. al-Asbaj as-Sulamî, written about 231 A.H./845 A.D. known as 'Kitab Asmâ' Jibâl Tihâmah wa Makâniha' which deals with the mountains of Tihâmah in Arabia. This work is mentioned by as-Sîrâfî. Yaqût, the famous thirteenth century geographer, also mentions another book by the same author bearing the title 'Jazîrat al-'Arab' (Isle of Arabia). This reference is found in the 'Dictionary of Learned Men'—'Mu'jam al-Udabâ',' Vol. III, p. 86.[1]

A geographer of outstanding fame was Ya'qûbi (Aḥmad b. Abî Ya'qûb b. Ja'far b. Wahab b. Wâḍeh al-'Abbâsî) who was an Egyptian of the family of Abbasid Caliphs and a Shi'ite.[2] He was at the Tâhirid Court in Khurâsân and was a widely travelled man, having visited India and the Maghrib (N. W. Africa) Ya'qûbi came back to his native land after his extensive wanderings and died there in 284 A.H./897 A.D. He wrote something resembling a modern gazetteer, called 'Kitâb al-Buldân' (Book of Countries) in 278 A.H./891 A.D. The

1. Brockelmann : Supplement Bd. I.
2. Huart : *History of Arabic Literature*, p. 292.

work gives details about numerous places and here and there attempts are made to state facts of physica geography, explaining the human geography of many areas. It begins with a detailed description of Baghdâd and Samarra, and then deals with Irân, Tûrân and what is now modern Afghanistan. Topographical details of Kûfah and Baṣrah are provided and then follow descriptions of Central and South Arabia, Syria, Egypt, Nubia and the Maghrib. But it is unfortunate that chapters on India, China and the Byzantine Empire have been lost.[1] Details of the high roads across Irân are found fully set forth only in this work. He was particularly interested in the statistical and topographic aspects. Ya'qûbî, is sometimes popularly known as the " father of Muslim Geography". Perhaps, this is due to the fact that his work received earlier attention in the West.

Ja'far b. Aḥmad al-Marwazî (d. 274 A.H./887 A.D.) wrote his 'Kitâb al-Masâlik wa'l Mamâlik' which seems to be of considerable importance as it was mentioned by Ibn an-Nadîm in " Fihrist " (p. 150) and also by Yaqût in 'Mu'jam al-Udabâ' (Vol. II, p. 400)[2].

Al-Balâdhurî (Aḥmad b. Yaḥyâ b. Jâbir) was a great historian whose reliability and critical powers are much appreciated. Though he was not primarily a geographer, he discussed geographical topics in many places in his writings. For example, he refers in his 'Futûḥ al-Buldân' to the bursting of the banks of the Tigris in the Sassanian period. He was educated at Baghdâd during Mâmûn's times and wrote 'Futûḥ al-Buldân' about 869 A.D. According to Yaqût in 'Mu'jam

1. *Encyclopaedia of Islam*, Vol. IV, p. 1153.
2. See Brockelmann : Supplement, Bd. I.

al-Udabâ' ' (Vol. II, p. 131) he had written two more books, 'Kitâb al-Buldân al-Ṣaghîr' and 'Kitâb al-Buldân al-Kabîr,' which have not come down to us. In 892 A.D. he died of mental derangement after drinking balâdhur (Indian *bhang*), hence his designation.

Al-Hamadânî (Abû Bakr b. Muḥammad b. Isḥâq b. al-Faqîh) was born in Hamadân, a famous city of Irân. He flourished during the reign of Al-Mu'tadhid at Baghdâd and is known as the author of a geographical miscellany, 'Kitâb al-Buldân' (Book of Countries) which was probably written in 902 A.D. We only possess an abridgement made by 'Alî Ibn Ja'far Shaizarî (413 A.H./ 1022 A.D.).[1] It was an important work and is often quoted by Mas'ûdî and Yâqût.

Ibn Rustah (Abû 'Alî Aḥmad b. Muḥammad b. Isḥâq b. Rustah) was the author of an encyclopædia (Al-A'lâq al-Nafîsah) the seventh volume of which (now in the British Museum) deals with geography. His work was compiled at Iṣfahân in 290 A.H. (903 A.D.). Though Ibn Rustah's geographical writings have an astronomical bias, his discussions deal with a variety of topics, like the extent of the earth, the founding of Mecca and Medina, seas, rivers, climate, as well as the geography of Irân and adjoining lands.

But to a geographer, of the utmost interest is his most minute account of the great Khurâsân road as far as Ṭûs (near modern Mashhad) with some of its branch roads, notably those going to Iṣfahân and Herat; also

1. Work has been edited by Prof. Aḥmad Zaki Validi of Turkey and the text of the epitome of Hamadāni's work forms the 5th Vol. of *Bibl. Geog. Arab.* Ed. de Goeje, Leiden, 1885. Also see Le Strange : *Palestine under the Muslims*, p. 4.

the roads from Baghdâd to Kûfah and Baṣrah with the continuation to Shîrâz. In addition to remarks about exact distances and prominent stages on these roads Ibn Rustah describes the relief of the areas traversed, and this has helped in the fixing of many sites of towns which no longer exist.

Ibn Serapion is an altogether obscure geographer and only a few details about him are known. He was a Copt (Egyptian Christian), and compiled his work about the year 945 A.D., after the taking of Baghdâd by Buwaihids. He is said to have made a chart describing 'Iraq with special reference to Baghdâd and parts of Mesopotamia. He wrote about the river and canal system of Mesopotamia and added shorter descriptions of rivers in other provinces. Le Strange has utilised his work in connection with his two books.[1]

Ibn Faḍlân (Aḥmad b. Faḍlan b. 'Abbâs b. Rashîd b. Ḥammâd) is one of the earliest traveller-geographers, whose accounts of the Volga-Caspian regions are greatly valued. He was sent by Caliph Al-Muqtadir in Ṣafar 309 A.H. (June 921 A.D.) as an envoy to the king of Volga Bulghars, where he arrived on the 13th Muḥarram 310 A.H. (11th May, 922 A.D.). On his return to Baghdâd he described his journey in the form of a bock which is perhaps the first reliable account of an area about which very little was known till then. Yaqût later on probably utilised this source in his work.

1. *Lands of the Eastern Caliphate* and *Baghdâd under the Abbasid Caliphate.*

Another work of considerable importance by Ibn Faḍlân is his 'Risâlah' (Travel Book) which has recently been discovered by Prof. Zakî Valîdî at Mashhad.[1]

Abu'l Faraj (Qudâmah b. Ja'far al-Kâtib al-Baghdâdî) was an accountant in Revenue Department at Baghdâd who died 310 A.H. (922 A.D.). He wrote 'Kitâb al-Kharâj' (Revenue Book), a book which deals with land-tax, but in the introduction the author deals with the organisation of postal services and provides a summary of the geography of the Arab Empire and the adjoining countries.

Al-Jaihânî (Abû 'Abdullâh Muḥammad b. Aḥmad) was a minister at the Samanid Court between 279-295 A.H. (892-907 A.D.). He compiled a work on the lines of Qudâmah's 'Kitâb al-Kharâj.' This work has been lost, but Sprenger is of the opinion that perhaps Idrîsî utilised it in describing many parts of Asia. Another outstanding traveller-geographer was Abû Dulaf (Mis'ar b. al-Muhalhal al-Khazrajî al-Yanbû'î). He was born at Yanbû' near Mecca and later lived as a poet at the Court of the Samanid Prince Naṣr b. Aḥmad b. Ismâ'îl, from 301-331 A.H. (913-942 A.D.). In 331 A.H. (942 A.D.) an Indian envoy is said to have come to this court on a mission of goodwill from an Indian Prince Kalatlî b. Shakhbar.[2] Abû Dulaf went with the mission on its return journey and visited Kashmîr, Kâbul, Sîstân, and the Malabâr and the Coromandal coasts. On his return he wrote 'Ajâib al-Buldân' (Wonders about Countries). This work was later utilised by Yâqût and Qazwînî.

1 Prof. Z. Validi's contributions in *Journal Asiatique*, Vol. 204, p. 144, and *Geographische Zeitschrift*, 1934, Vol. I, p. 363.

2. Brockelmann, p. 228.

Al-Balkhî (Ābû Zaid Aḥmad b. Sahl) was born near Balkh in Shâmistân. He went to 'Irâq for his education and became a pupil of the famous philosopher Al-Kindî, under whom he studied history and philosophy. On his return to his native land he took up service under the prince of Balkh (Āḥmad b. Sahl b. Hâshim al-Marvazî who died in 307 A.H./919 A.D.). Balkhî is one of the early Muslim map-makers and most of his work 'Kitâb al-Ashkâl' or 'Sûrat al-Aqâlîm' (Figures of Climes) consists of explanations of charts. He also wrote on 'Routes and Kingdoms' (Kitâb al-Masâlik wa'l Mamâlik). His works were compiled in 309 A.H./921 A.D. and he died in 322 A.H./934 A.D.

Another geographer about whom few biographical details are available is Al-Iṣṭakhrî (Abû Isḥâq Ibrâhîm b. Muḥammad al-Fârisî), who must have lived in the first half of the fourth century A.H. (10th A.D.) as there is evidence of his contact with Ibn Ḥawqal in 340 A.H. (951-52 A.D.) or according to De Goeje between 318-21 A.D. Iṣṭakhrî wrote on 'Routes and Kingdoms,' and his book is based upon Balkhî's earlier work of the same name. In his work also maps play an important part. He was a native of Iṣṭakhr in Fârs (in Irân).

Ibn Ḥawqal (Abu'l-Qâsim Muḥammad) is noted for his extensive travels which lasted no less than 30 years. He left Baghdâd in Ramaḍân 331 A.H. (May 943 A.D.), and travelled throughout the Muslim world gathering a store of knowledge and experience. He had studied Khurdâdhbih and Jaihânî and met Iṣṭakhrî in 340 A.H. and at the latter's request revised his work and maps, but later on rewrote it under the same name about 367

A.H. (977 A.D.). Dozy believes that he was a spy in the service of the Fatimids but that does not lessen the merit of his compilation and labour.

Al-Mas'ûdî (Abu'l Ḥasan 'Alî b. Ḥusain) is famous both as a historian and a geographer, and was certainly one of the most versatile of the fourth century writers. He belonged to an Arab family and was born at Baghdâd. Mas'ûdî early acquired a 'Wander-lust' and in his youth travelled far and wide, visiting various parts of India, especially Sind, the Punjab, Konkan and Malabâr and after passing through Ceylon went onward to the China Sea, returned to Zanzibar and Madagascar and later arrived back in 'Umân on his way to Baghdâd. After a short while he travelled along the southern shores of the Caspian Sea and visited Asia Minor, Syria and Palestine. In 305 A.H./915 A.D. he was in Iṣṭakhr. He came to Egypt during the later years of his life and died at Fusṭâṭ in 345 A.H./956 A.D. It seems that Mas'ûdî had made a thorough-going study of the geographical literature available in his times and, therefore, he has been able to mention references to numerous works now not extant. Many of his geographical ideas are traceable to Kindî and Sarakhsî and he himself mentions meeting Abû Zaid Sîrâfî. But in several places he breaks fresh ground as a result of his deep observation, vast experience and extensive knowledge. 'Marûj al-Dhahab wa Ma'âdin al-Jawahar' (Meadows of Gold and Mines of Precious Stones) is a record of Mas'ûdî's travel experiences and observations. Fortunately the text of this great work is available to the modern reader and reveals the writer's geographical ideas.

Al-Ḥâ'ik (Abû Muḥammad al-Ḥasan b. Aḥmad b. Ya'qûb al-Hamadânî b. al-Ḥâ'ik, the weaver) was a man well-versed in history, but he was also a geographer of no mean merit, besides being an astronomer and a poet. He came from a Yemenite family and was very much interested in the folk-lore of ancient South Arabia. He wrote 'Kitâb-Jazîrat al-'Arab' (A Geography of Arabia)—dealing with its physical features, races, tribes, animal and mineral products, routes and settlements, etc. He also wrote 'Al-Aklîl' about forts and graves and other archæological aspects of Yemen. Unfortunately many details about him are not known. He is said to have died at Ṣan'â in prison in 334 A.H./945 A.D.

Al-Maqdisî, also sometimes known as Muqaddasi (Abû 'Abdullâh Muḥammad b. Aḥmad), was a native of Palestine and was born in Jerusalem. His fame as a geographer is widely recognised in the West. Maqdisi was a great traveller and visited all parts of the Islamic world except India and Spain. In his writings he reveals himself as a very close observer of life and professions. and seems to have a great insight into the literature of the lands which he visited. He wrote 'Aḥsan al-Taqâsîm fî Ma'arfat al-Aqâlîm' (the Best of Divisions for the Knowledge of the Climes) in his fortieth year, at Shîrâz in Fârs, in 375 A.H. (985 A.D.). According to Maqdisi, geography had received scant attention from the scientific writers who had preceded him, and, therefore, he took upon himself the task of collecting data from all parts of the Islamic world based upon personal travel and observation, and presented them in a coherent form for the proper understanding of the life, manners, and needs of peoples. His method is best set forth in his

own words[1]: "I thought it expedient therefore to engage in a subject which they (scientists and writers) have disregarded and to single out a branch of knowledge of which they have not treated save imperfectly—and that is the chorography (geography) of the empire of Islam, comprising a description of the deserts and seas, the lakes and the rivers that it contains, its famous cities and noted towns, the resting-places on its roads and highways of communication; the original sources of spices and drugs; and the places of the growth and production of exports and staple commodities and containing an account of the inhabitants of different countries as regards the diversity in their language and manner of speech . . . the hills, plains, and mountains, the limestones and the sandstones, the thick and thin soils, the lands of plenty and fertility . . . the various states and their boundaries; the cold and the hot regions and the rural and frontier districts." It is amazing to note how near he comes to the conceptions of a modern geographer as regards the utility of the subject for general education; for he says: "I recognised that this subject is an all-important one for travellers and merchants. It is desired by princes and noble personages, sought for by judges and doctors of law, the delight of commoners and men of rank."

Among the geographers whom Maqdisî had consulted were Khurdâdhbih, Jaihânî, Balkhî, Hamadânî and Jâhiz. He discusses their merits and drawbacks very frankly. Accompanying his description of the lands of Islam, which he divided into fourteen divisions or

1. *Maqdisî*, pp. 2-3.

provinces, Maqdisî prepared separate maps[1] for each division, and in these maps he used symbols and methods of representation of relief, etc. for their proper comprehension by all. In his maps, routes were coloured red; the golden sands, yellow; the salt seas, green; the well-known rivers blue; and the principal mountains drab.

He considered the earth to be nearly spherical in shape, divided into two equal parts by the equator, and having 360 degrees of circumference, with 90 degrees from the equator to each pole. He conceived of the southern hemisphere as mostly consisting of water and the northern as having the concentration of land.[2] In connection with the description of his 'climatic' zones he gives numerous details of physical and human geography. On the whole his descriptions of places, of manners and customs, of products and manufactures, and his brief geographical accounts of individual provinces are some of the finest written pages in the whole range of mediæval Arab literature.[3] Two copies of his work are available, one is the Constantinople manuscript and the other is in Berlin.

A geographical work of considerable importance written towards the close of the tenth century A.D. which has only recently[4] come to light is 'Ḥudûd al-'Âlam' (the Regions of the World) written in Persian by an

1. *Maqdisî*, p. 12.
2. *Ibid.*, pp. 99-100.
3. Le Strange : *Lands of the Eastern Caliphate*, p. 13.
4. The Russian orientalist, Capt. Toumansky had asked Mirzâ Abu'l Fadl Gulpayagâni of Samarqand to look for old manuscript in that area. On 25th October, 1892, the Mirzâ wrote to him mentioning the discovery of *Hudûd-al-'Âlam*. Toumansky first mentioned the manuscript in an article in 1986—Minorsky, Translator's Preface, ix.

unknown author. It was compiled in 372 A.H. (982-83 A.D.), and is dedicated to the Amîr 'Abdul Ḥârith Muḥammad b. Aḥmad, of the local Farighunid Dynasty which ruled in Guzganan, now Northern Afghanistan.[1] The unique manuscript was copied in 656 A.H. (1258 A.D.) by Abu'l Mu'ayyid 'Abdul-Qayyûm b. al-Ḥusain b. al-'Ali al-Fârisî.

The book deals with the geography of such distant areas as India, Tibet, China, Turkistan, Volga Bulghars, Caucasus, Spain and Eastern Europe, etc. There are more detailed accounts of the author's native land. Prof. Minorsky considers it conspicuous for its well-balanced brevity and believes that perhaps it was written as a 'preface to a map' to which the author refers again and again. Unfortunately no trace of such a map is available. He is also of the opinion that Balkhî, Iṣṭakhrî, Khurdâdhbih, and possibly Ibn Ḥawqal were the sources which were largely used by the writer of 'Ḥudûd al-'Âlam.' Before describing the various parts of the inhabited world the author devotes chapters to seas, islands, mountains, rivers, and deserts.

Muhallabî was the author of an outstanding geographical work dealing with Sudan, which was written for the Fâṭimid Caliph Al-'Azîz in 375 A.H. (985 A.D.). It was the first book of its kind about this area and later formed Yaqût's main source for the geography of Sudan.

Al-Bîrûnî (Abû Raiḥân Muḥammad b. Aḥmad) has rightly been called one of the greatest scientists of all times. He holds a unique position among Muslim scholars. He was a scientist, historian, naturalist,

1. Minorsky, V. : *Hudūd al-'Ālam*, (Translator's Preface, vii).

geologist, mineralogist, astronomer and mathematician and had studied chronology and medicine. He had a keen geographical sense and his conclusions in that connection deserve high merit. His breadth of views and wide range of knowledge was amazing indeed.

Al-Bîrûnî was born in one of the suburbs of Khawârizm (Khîvâ) in 362 A.H./972 A.D.—hence his designation. Even before 407 A.H./1017 A.D. when he was captured by Sulṭân Maḥmûd of Ghaznî on the fall of Khîvâ, he was a scholar of much high repute and his "Chronology of Ancient Nations" (Al-Âthâr al-Bâqiah) belongs to this period. He was taken to Ghaznî and later accompanied the Sulṭân on several of his seventeen campaigns in North-western India. There he learned Sanskrit and devoted himself to the study of Hindu sciences. The result of his study and travels was 'Taḥqîq ma fi'l Hind' (Kitâb al-Hind—popularly known as Al-Bîrûnî's India) which was published after the death of Sulṭân Maḥmûd, *i.e.* 421 A.H./1030 A.D. During the time of Sulṭân Mas'ûd he wrote his monumental work "Qânûn al-Mas'ûdi" (Canon Masudicus) and then in the days of his successor Mawdûd two notable books, *i.e.* 'Kitâb al-Tafhîm' and the 'Book on Stones' (Kitâb al-Jamâhir fi'l Ma'arfat al-Jawâhir) in which he discussed the sources and characteristics of many precious stones and pearls.[1] He died after 442 A.H./1050 A.D. and not in 440 A.H./1048 A.D. as commonly supposed.[2] Till his very last days, past the age of 80, Al-Bîrûnî kept his intelligence and vast knowledge intact.

1. Chapter on Pearls in the *Book on Precious Stones*, by Al-Birūni, trans. F. Krenkow, *Islamic Culture*, Vol. XV, No. 4, 1941.

3. Meyerhof: *Art on Aconite* from Al-Birūni's *Kitāb-as Saydāna*, *Islamic Culture*, No. 4 October, 1945, p. 323.

By reason of his profound knowledge of facts and the ability to use them, his 'Kitâb-al-Hind' may be regarded as one of the most significant productions in the field of regional geography. He also tackled such subjects as mineralogy and geology, the best example of his speculation in the latter field being his explanation of the origin of the plain of Hindustan, which area, according to him, was formerly the bed of a sea and was later filled up by alluvial sediment. The remarkable closeness of this view to the modern conception can best be shown by Al-Bîrûnî's own words. He says, ". . . one of these plains is India, limited in the south by the above-mentioned Indian Ocean, and on three sides by lofty mountains, the waters of which flow down to it. But if you see the soil of India with your own eyes and meditate on its nature, if you consider the rounded stones found in the earth however deeply you dig, stones that are huge near the mountains and where the rivers have a violent current, stones that are of smaller size at a greater distance from the mountains and where the streams flow more slowly, stones that appear pulverised in the shape of sand where the streams begin to stagnate near their mouths and near the sea—if you consider all this, you can scarcely help thinking that India was once a sea, which by degrees has been filled up by the alluvium of the streams."[1] Further, his remarks having a bearing on physical geography, which are many, are of a high order. In describing the geography of Asia and Europe, he mentions a continuous chain of mountains from the Himalayas to the Alps. He makes a distinc-

1. Sachau : *Al-Birūnī's, India* Vol. I, p. 198.

tion between a gulf and an estuary; the latter, he says, is a part of the river at its mouth while the former is an extension of the sea penetrating for some distance into the land.[1] Al-Bîrûnî gives a better idea of the inhabitable world than many of his predecessors: he believed in the southern extension of the African continent and the navigability of the ocean in the south. His numerous details about the geography of India include the frontiers of the country, its physical build, the nature of rainfall, the chief itineraries radiating in all directions from Kanoj, the commercial activity of many towns and littoral areas and the animal and plant life of the country. From a sociological point of view he discusses the prohibition of beef-eating and explains how, India being a hot country, cow's meat was not easily digestible and also that the land being mostly agricultural the slaughter of cattle was regarded as detrimental to economic life.[2]

He clearly understood the phenomena of tides and explained how the increase and decrease in ebb and flow develop periodically and parallel with the moon's phases and he adds that such things are known to the people living near the sea-shores. Describing the situation of Somnath[3] he says that the place owes its name to the ebb and flow of water, hence "master of the moon." Each time the moon rises and sets, the water of the ocean rises in flood so as to cover the place, and later, when the moon reaches the meridian of noon and midnight, the water recedes in the ebb. According to him the educated Hindus used to determine the daily

1. Sachau : *Al-Birūni's India*, Vol. I, p. 210.
2. *Ibid*., Vol. II, pp. 152-53.
3. *Ibid*., pp, 104-5.

phases of the tides by the rising and setting of the moon, the monthly phases by the increase and waning of the moon; but he was of the opinion that they did not understand the physical cause of both phenomena.

On the mathematical and the astronomical side of geography Al-Bîrûnî discusses the antipodes and the roundity of the earth, the determination of its movements, and gives the latitudes and longitudes of numerous places. An interesting yet significant incident in this connection is the report of a Turkish envoy who came to the Court of Sulṭân Maḥmûd at Ghaznî and narrated how beyond the seas towards the South Pole he had observed the sun on the horizon in a manner that the night became non-existent. The Sulṭân could not believe such a fantastic story and called in Al-Bîrûnî to explain, which the great savant did to the satisfaction of the monarch.[1]

Finally, an extract from Al-Bîrûnî's writings may be quoted to show not only his understanding of geography but also how he valued the spread of Islam throughout the world in order to promote and assure the collaboration of different nations in the advancement of knowledge. He says,[2] "My object therefore is to establish the geographic longitude of a certain city on the earth-globe, that is to say, Ghazna. Hitherto I have been able to show what concerns the longitude, I was not able to establish that properly owing to adverse circumstances. But if I were to plead these obstacles as an excuse for such negligence and were to show my-

1. Yâqût: *Mu'jam al-Udaba'*, Vol. VI, p. 310.

2. Quoted from *Taḥdîd an-Nihâyat al-Amâkin*, by Prof. Aḥmad Zaki Validi, *Islamic Culture*, Vol. VIII, 1934, pp. 517-18.

self as therefore blameless, I should have portrayed myself as a denier of God's open and secret favours as well as of the benefits of the Dispenser of Kindnesses (*i.e.* of the ruler, Maḥmûd of Ghazna) whose hand has brought me unto full prosperity. Something quite different ranks with me as obstacle. I have in mind some other scientific questions, which I pray Almighty God that I may master questions which attract me, and my resolve to deal properly with which will never be shaken even if I were to stand on the brink of an abyss of danger for my soul and for my body. I hasten to make this problem my own in order that I may have completed it before the coming of the fearful hour (of death).

And I say : Most of the data of the 'Geography' (of Ptolemy) concerning the longitude and latitude of points on the earth have really been adopted only on the ground of rumours which had come from far-off districts. In the practical use of such data Ptolemy himself must have hit on the right way ; but others have only imitated him and it is possible that the latter, moreover, have diverged from the right way. Anyhow, the ground on which these data rest is mere report ; indeed those lands were very difficult of access in the past owing to the national divisions (at-Ṭubâyan al-Millî), for national division is the greatest obstacle to travel in countries. We see, for example, some peoples who think—as do the Jews—to come nearer to God through treacherous attacks on folk of other nationalities. Or they take foreigners as slaves, as do the Romans, and that is the lesser evil. Or travellers, because they are foreigners, are turned back, held in

every kind of suspicion and they are thus brought to a very unpleasant and dangerous plight.

But now (the circumstances are quite different). Islam has already penetrated from the eastern countries of the earth to the western; it spreads westward to Spain (Andalus), eastward to the borderland of China and to the middle of India, southward to Abyssinia and the countries of Zanj (*i.e.* South Africa, the Malay Archipelago and Java), northward to the countries of the Turks and Slavs. Thus the different peoples (al-Umam al-Mukhtalifah) are brought together in mutual understanding (ulfat), which only God's own Art can bring to pass. And of those (who could be obstructive to cultural relations) only common vagabonds and highway robbers are left. The remaining obstinate unbelievers have become timid and tame; they now respect the followers of Islam and seek peace with them.

To obtain information concerning places of the earth has now become incomparably easier and safer (than it was before). Now we find a crowd of places, which in the (Ptolemaic) "'Geography' are indicated as lying to the east of other places, actually situated to the west of the others named, and *vice versa*. The reasons (of such errors) are either confusion of the data as to the distance on which the longitude and latitude were estimated, or that the populations have changed their former places."

Nâṣir-i-Khusrau, the Persian traveller, also belongs to this period and was born in the neighbourhood of Balkh in 1003 A.D. He passed through Palestine on his way to Mecca and was in Jerusalem in 1047 A.D.

Earlier he had travelled in India and lived at the Court of Sulṭân Maḥmûd. His travel diary (Safar-nâmah) was written in 1045 A.D. in Persian and has been translated by Le Strange. His is the best account of Jerusalem before the Crusades.

Spain also produced several geographers of outstanding merit—men who travelled widely, observed minutely and wrote exhaustively. Al-Bakri (Abû 'Ubaid 'Abdullâh b. 'Abdul 'Azîz) was born at Cordova in 432 A.H. (1040 A.D.) and died there in 487 A.H. (1094 A.D.). He wrote a 'Geographical Dictionary' (Mu'jam Ma Ista'jam), and also a book on 'Routes and Kingdoms' (Al-Masâlik wa'l Mamâlik). Bakrî seems to have studied a wide range of subject-matter before compiling his own work. One of his main sources was the Spanish geographer Muḥammad al-Ṭâriqî, died 363 A.H. (973 A.D.), who had written about North Africa. Another source was the work of Ibrâhîm bin Ya'qûb, a Jewish merchant and slave-dealer, who was a Spaniard and had travelled through Germany and the Slav countries during the reign of Otto the Great.

A notable geographer was Muḥammad bin Abû-Bakr az-Zuhrî of Granada, who is one of those few writers who gave to their work the name of geography. He is the author of a 'Book of Geography' (Kitâb al-Jughrâfiyah) and lived towards 532 A.H. (1137 A.D.). It is said that in the time of Caliph Mâmûn, seventy geographers completed a work, of which only a few pages[1] are now in the Bibliotheque National, Paris, No. 2220. This work was utilised by Al-Fazârî and

1. Brockelmann : Supplement, Bd. I.

Al-Kumarî and their work in its turn was used and enlarged upon by Az-Zuhrî in his 'Book of Geography.'

But the most famous Spanish writer on geography was Al-Mâzinî (Abû 'Abdullâh Muḥammad b. 'Abdur-Raḥim al-Mâzinî al-Qaisî al-Andalusî), who was born in Granada in 473 A.H. (1080 A.D.). He came to Egypt in 508 A.H. (1114 A.D.) and went to Baghdâd in 556 A.H. (1161 A.D.). For a considerable time he studied in Khurâsân and later at Alleppo and died at Damascus in 565 A.H. (1169 A.D.). One of his works is a geographical description of his journeys (Tuḥfat al-Albâb wa Nukhbat al-A'jâb). Another account of his journeys through Spain, Africa, Damascus, Ardbil, the Caspian Coasts, Derband and the land of Khazârs is known as 'Nukhbat al-Adhân fî 'Ajâib al-Buldân'. Two more well-known works are: 'Al-Maghrib 'An Ba'ḍ 'Ajâib al-Buldân' (dealing with Maghrib) and 'Tuḥfat al-Kibâr fî Ash'âr al-Baḥâr' (dealing with sea voyages), a copy of which is in the Historical Academy, Madrid.

A geographer who seems to be a Spaniard was Al-Munajjim (Isḥâq b. Ḥusain), who is supposed to have worked in fourth century Hijrâ between the period 340 A.H. (951 A.D.) and 454 A.H. (1063 A.D.) in Morocco. His book deals with many cities (Kitâb Âkâm al-Marjân fî Dhikr al-Madâ'in al-Mashhûrah Bikul Makân—A Geographical Dictionary). The main importance of this work lies in the fact that celebrated writers like Idrîsî and Ibn Khaldûn utilised it.

Abû Muḥammad al-'Abdarî of Valencia wrote an account of his journey through North Africa in 688 A.H. (1289 A.D.).

Ibn Jubair (Abu'l Ḥusain Muḥammad Ibn Aḥmad Ibn Jubair al-Kinânî) was also of Valencian extraction and was born in 1145 A.D. Among his countrymen he enjoyed a high literary reputation as a poet. But to the geographer his greatest contribution is the journal which he kept during his first journey to the East in connection with a pilgrimage to Mecca towards the end of the sixth century Hijra. He published this diary soon after his return to Spain under the title 'Riḥlat Ibn Jubair' (Travels of Ibn Jubair). It became very popular both in the East and the West, but unfortunately only one MS.[1] has come down to our times. His accounts throw interesting light on the geography and cultural and commercial activity of the Muslim parts of the Mediterranean lands. Writings of Ibn Jubair were utilised by many notable writers and historians after him, like Al-'Abdarî, Al-Balawî, Ibn al-Khaṭîb, Al-Maqrizi, Al-Fâsî, Al-Maqqarî and Ibn Baṭṭûṭa. In his later years he taught at Malaga and then at Fez and Ceuta and died in 1217 A.D.

Ibn Sa'îd (d. 1274 A.D.) wrote a notable geographical work called 'Kitâb Jughrâfiah fi'l Aqâlîm' of which only an extract has been handed down. Though the treatment was on the basis of 'Climates' (Âqâlîm) but the latitudes and longitudes of many places are added and facilitate the reconstruction into a map. The writer made use of many new facts including the significant story of Ibn Fâṭima's travels along the West African coasts and the descriptions of tribal orientations in North Africa after the times of Almohades (al-Mu'waḥḥidûn).

1. Wright : *Travels of Ibn Jubair*, p. 14.

Al-Idrîsî (Abû 'Abdullah Muḥammad b. Muḥammad b. 'Abdullah b. Idrîsî ash-Sharîf) is perhaps the best known Muslim geographer in the West. His travels through Europe and his long residence at the Court of the Christian King of Sicily, Roger II, entitled Idrîsî to be taken notice of by Europe much earlier than the others. He came of an 'Alid family and was born in Ceuta in 493 A.H. (1099 A.D.) and was educated at Cordova. After his long travels through the world of Islam and Europe he was persuaded by King Roger to settle down at the Court of Palermo. There, in 548 A.H. (1154 A.D.), he wrote a treatise, 'Amusement for him who Desires to Travel Round the World' (Nuzhat al-Mushtaq fi' Ikhtirâq al-Âfâq) also known as 'Kitâb Rugârî' (Book of Roger.) About the same time he also made a celestial sphere and a representation of the known world in the form of a disc, which gives him an outstanding place among the Muslim cartographers. In giving the finishing touches to his work, Idrîsî was in an advantageous position, because Sicily, set almost in the centre of the Mediterranean, was the rendezvous of ships and navigators from the Northern waters, the Atlantic, and the Mediterranean. Idrîsî's knowledge of the Niger above Timbaktu and of the head-waters of the Nile and the Sudan is remarkable for its accuracy. His work is certainly the most notable example of the fusion of ancient and modern geography. A modern geographer[1] has rightly remarked, "In view of its 'modernity' and high intrinsic worth, it is difficult to

1. Kimble: *The Geography of the Middle Ages*, p. 59 He also mentions that the first known translation (into a European language) of Idrisi's work was published in Rome in 1619 and that this was in a much abridged form and the translator did not even know the author's name.

understand why Idrîsî's work, composed as it was at the chronological and geographical point of contact between the Islamic and Christian civilisations, remained so long unutilised by Christian scholars in Sicily, Italy or other Christian countries until we remember that the primary, we might almost say, the sole interest, of the Latin West in Arabic literature centred in the preparation of calendars, star tables and horoscopes, and the recovery of ancient lore. It was not much concerned in the twelfth century with the descriptive geography of Africa or Asia." One great feature of Idrîsî's work is the absence of unreserved approval of Ptolemy's ideas in the light of his personal knowledge and varied experiences as a highly travelled man.

Al-Mawṣulî (Muḥammad b. 'Alî b. Muḥammad al-Anṣârî) was a writer of a book of travels "'Ayûn al-Akhbâr,' giving descriptions of his journey through Syria, Palestine and Egypt, during the period 537-585 A.H. (1142-1189 A.D.). The book was written in Ceuta and also contains names of scholars of note whom the author had met. Another book of this type was written by Shaikh al-Ḥarawî dealing with the most frequently visited places of pilgrimage in the eastern part of the Islamic world (Ishârat 'Alî Ma'arfat al-Ziârât). He died in 611 A.H. (1214 A.D.).

Yâqût Ḥamavî (Ibn 'Abdullah ar-Rûmî) came of Greek parentage and was born in 574 A.H. (1179 A.D.). While yet a boy he was captured and later purchased by a Baghdâd merchant of the tribe of Ḥamat—hence the designation 'Ḥamavî'. Yâqût is one of the most celebrated of Muslim geographers and his work is of tremendous importance as it gives us a picture of the

world of Islam just before the destruction of its culture and prosperity at the hands of the Mongols. Yâqût lived a truly adventurous life. First we find him undertaking commercial travels for his master, but after his third journey in 590 A.H. (1194 A.D.) to the island of Krish (in the Persian Gulf), he left his benefactor. He became a pupil of 'Ukbarî and after acquiring some learning became a bookseller and decided to write himself. In 610 A.H. (1213 A.D.) he again went on a journey, first to Tabriz, then to Mosul, Syria and Egypt. Two years later he started from Damascus on his eastern journey and came to Nîshâpûr in the following year and at Merv he studied many valuable works. Thus he equipped himself to write, but while at Balkh he heard of the first onrush of the Tartar hordes and quickly repaired to Mosul in 1220 A.D. His great 'Geographical Dictionary' (Mu'jam al-Buldân) was finished on the 13th March, 1224, and he died five years later at Alleppo. Yâqût was a self-made man of wide learning and varied experiences and his writings reveal enormous industry.

'Mu'jam al-Buldân' described in alphabetical order every town and place of which the author could obtain any information. Besides, the book gives detailed accounts of the Islamic lands from Spain to Transoxiana and India, as seen in the thirteenth century A.D. one Ṣafî al-Dîn (1300 A.D.) later abridged the text and made a few additions and entitled it as 'Marâsid al-Iṭṭilâ''[1]. Yâqût's other monumental work 'Mu'jam al-Udabâ'' (Dictionary of Learned Men) also provides useful geographical in-

1. Le Strange: *Palestine under Muslims*, p. 9.

formation, besides literary notices. He made a thorough study of the outstanding geographical works before his own and in fact references to several compilations no longer available are found in his books. That he displayed the critical method of a modern geographer is found in his criticism of Ptolemy's reference to places and towns in Arabia[1] when he mentions that he fails to identify many places given in the works of Ptolemy, since they no longer exist.

Al-Qazwînî (Zakariyâ b. Muḥammad b. Maḥmûd Abû Yaḥyâ) was born at Qazwîn in Jibal (N. Iran) in 600 A.H./1203 A.D. and belonged to a pure Arab family. In the reign of the last Abbasid Caliph Mu'taṣim, he was living in Iraq and filled the office of the Qâḍî of Wâsiṭ and Hilla. He died in 682 A.H./1283 A.D. We possess two works[2] of approximately the same size, one 'Cosmography' and another 'Geography'. His 'Cosmography' ('Ajâib al-Mukhlûqât wa-Ghrâib al-Mawjûdât) remained popular not only for centuries during the Middle Ages but down to the modern times. It consists of two parts, (1) dealing with heavenly things, (2) terrestrial. It also contains a great deal that is purely geographical, as it describes the more important mountains, islands, seas, rivers and springs. The ' geography ' exists in two editions with different titles, the older called ''Ajâib al-Buldân' and the later 'Âthâr al-Bilâd' (a Historical Geography) written in 1250 A.D. Here Qazwînî gives a description of the earth following the Ptolemaic division into seven climes (Iqlîm). The book is loaded with historical and biographical material. The text was accompanied by

1. M. Sulaimān Nadvi : *Arḍ-ul-Qur'ān*, Vol. I, p. 71.
2. *Encyclopædia of Islam*, Vol. II, pp. 841-44.

illustrations and pictures. No less than fifty authors are quoted by the writer in his 'Geography'. For portions dealing with Spain prominent Muslim geographers of that country, *i.e.* Al-Gharnâṭî, Al-Udhrî and Al-Andalusî are mentioned and for his remarkable information on French and German towns Qazwînî depends on personal contact with the Spaniard Ibrâhîm al-Ṭarṭushî (d. 477 A.H./1085 A.D.). Other authors consulted by him include Al-Jâhiz Ibn Faḍlân, Mi'sar al-Muhilhil and Al-Multânî Abu'l Rabi' Sulaimân (who had travelled in the interior of Africa).

Abu'l Fidâ (Ismâ'îl b. 'Alî b. Maḥmûd b. Shahanshâh b. Ayyûb 'Imâduddîn al-Ayyûbî) belonged to the ruling house of Ḥamat, a branch of the Ayyubids of Egypt, and was born in Damascus (672 A.H./1273 A.D.) where his father Al-Malik al-Afḍal, brother of the Amîr of Ḥamat, Al-Malik al-Manṣûr, had fled before the Mongols. His works display extensive knowledge and desirable balance in the selection of information and no wonder have gained wide recognition in Europe as typical of the later Muslim School of Geography. His main geographical work[1] is 'Taqwîm al-Buldân.'

Ḥamdullah Mustawfî's work 'Nuzhat al-Qulûb' is of special significance, because it was written in Persian and pictures the world of Islam in the East, after the tornado of the Tartar destruction had almost spent its fury. He wrote the book in 1340 A.D. in the days of Sulṭân Abû Sa'id the Ilkhan, the great grandson of Hulâgû. He was State Accountant (Mustawfî) in the

1. The French Orientalist Reinand in his useful commentary on Muslim geography, *Introduction General Geographie d' Aboulfida* and in the edition on *Taqwim al-Buldân* throws interesting light on his work.

service of the Sulṭân and by virtue of his office had access to revenue lists and other documents which equipped him with information not commonly available. 'Nuzhat al-Qulûb' gives detailed accounts of the varied geographical aspects, physical and human of all parts of the Islamic world. Iran and Central Asia receive special treatment. There is a comprehensive account of the seven seas and the islands therein. Japan, Java and Sumatra are mentioned among others.[1] A description of equatorial trees and animals is also given and the tropical luxuriance of these regions is particularly emphasised.[2] He also speaks of the change in the course of the Oxus in his own times which diverted the river from the Caspian to the Aral Sea. Hot springs and the Baku oil wells are mentioned. The chief authorities consulted by Ḥamdullah seem to be Ibn Khurdadhbih, Qazwînî and Yâqût. Though he cannot be credited with much originality yet in many of his accounts of towns and descriptions of provinces he has added something of his own as a result of personal observation and carefully gathered information. He also wrote a historical work called 'Târîkh-i-Guzîdah' (The Select History) which, besides being of considerable value for Mongol times, contains in many places geographical information of much importance.

Another geographer who shows much originality was Al-Dimishqî (Abû 'Abdullah Muḥammad b. Abî Ṭâlib al-Anṣârî al-Ṣûfî Shams al-Dîn) who died as Imâm of Rabwa in Syria in 727 A.H. (1327 A.D.). He is said to have written his geographical work 'Nukhbat al-

1. *Nuzhat al-Qulūb*, Chap. XX.
2. *Ibid.*, pp. 221-26.

Dahar fi' 'Ajâib al-Bar wa'l Baḥr' (Cosmography) about 1325 A.D. Among his sources may be mentioned Mas'ûdî, Ibn Ḥawqal and Yâqût. In addition, he gives names of many new places which remain unmentioned by his predecessors. For Arab's knowledge of South India[1] along the Malabar and Coromandal Coasts he is an important authority and gives the biggest list of place names. On the whole, Dimishqi was an original and painstaking writer and chose information carefully from various sources.

At this late period came a contribution of tremendous importance which has quite often received scant attention in the West ; this was the dictated account of his wanderings by Ibn Baṭṭûṭa. It is strange indeed how in paying due tribute to Marco Polo for his extensive travels we seem to take such little notice of a man of wide learning who travelled much more than the Venetian. Not many details are known about Ibn Baṭṭûṭa's life, apart from his accounts of his travels. He was born at Tangier on the 24th February, 1304, and died in 1369. He left Tangier on Thursday, 2nd Rajab 725 A.H. (14th June, 1325 A.D.), when he was twenty-two years of age, and his entire travels lasted for about thirty years, after which he finally returned to Fâs (Fez) in Morocco at the Court of Sulṭân Abû 'Inân and dictated accounts of his journeys to Ibn Juzayy These are known as the famous Travels (Riḥla).

Abû 'Abdullah Muḥammad ibn Baṭṭûṭa, also known as Shams ad-Dîn, was in fact the only medieval traveller who is known to have visited the lands of every Muslim ruler of his time, quite apart from Ceylon, China and

1. Nainar : *Arab's Knowledge of South India*, p. 19.

Constantinople. The mere extent of his wanderings is estimated by Yule at not less than 75,000 miles, without allowing for deviations, a figure which is not likely to have been surpassed before the age of steam[1]. In the course of his first journey he travelled through Algiers, Tunis, Egypt, Palestine, and Syria to Mecca. After visiting Iraq, Shiraz and Mesopotamia he once more returned to perform the Ḥajj at Mecca and remained there for three years. Then travelling to Jeddah he went to Yemen by sea, visited Aden and set sail for Mombasa (E. Africa): after going up to Kulwa he came back to 'Umân and repeated his pilgrimage to Mecca in 1332 *via* Hormuz, Sîrâf, Baḥrain and Yamâmâ. Afterwards he set out with the purpose of going to India, but on reaching Jeddah he changed his mind and revisited Cairo, Palestine and Syria, thereafter arriving at Aleya (Asia Minor) by sea and travelled across Anatolia to Sinope, whence he crossed the Black Sea to Kerch in the Crimea, and, after long wanderings over the Kuban steppes to the mouth of the Volga, accompanied a Greek Princess (Khâtûn Baylun) to Constantinople through Southern Ukraine. On his return from the Byzantine capital he came back to Astrakhan and thence entered Khurasan through Khwârizm (Khîva) and having visited all the important cities like Bukhara, Balkh, Herat, Ṭus, Mashhad and Nishapur he crossed the Hindu Kush mountains by the 13,000 ft. Khawak pass into Afghanistan and passing through Ghazni and Kabul entered India. After visiting Lâhirî (near modern Karachi), Sukkur, Multan, Sirsa, and Hansi, he reached Delhi. For several years Ibn-Baṭṭûṭa enjoyed the patronage of

1. Gibb : *Ibn Baṭṭûṭa*, p. 9 (Introduction).

Sulṭân Muḥammad Tughlaq, and was later sent on an embassy to China. Passing through Central India and Malwa he took ship from Kambay for Goa, and after visiting many thriving ports along the Malabar Coast he reached the Maldive Islands, from which he crossed to Ceylon and climbed Adam's Peak. Continuing his journey he landed on the Ma'bar (Coromandal) Coast and once more returning to the Maldives he finally set sail for Bengal and visited Kamrup, Sylhet and Sonargaon (near Dacca). Sailing along the Arakan Coast he came to Sumatra and later landed at Canton *via* Malaya and Cambodia. In China he travelled northward to Peking through Hangchow. Retracing his steps he returned to Calicut and taking ship came to Dhafari and Muscat, and passing through Fârs, Iraq, Syria, Palestine and Egypt made his seventh and last pilgrimage to Mecca in November 1348 A.D. Returning homeward he came to Tunis through Egypt and Cyrenaica and went to Sardinia by ship, later reaching Fez. But Ibn Baṭṭûṭa's 'wander lust' was not quenched until he had visited Muslim Spain and the lands of the Niger across the Sahara.

Historically Ibn Baṭṭûṭa's travels came at a period when the majority of the Tartar conquerors had been converted to Islam, and as a consequence the political conditions in the Islamic lands were relatively stable. But what interests a modern geographer is neither his accounts of the wealth, generosity, or eccentricities of Sulṭân Muḥammad Tughlaq, the piety of noble-minded Shaikhs, nor the number of the lovely slave-girls he possessed but descriptions of varying natural environ-

ment, products of far-off lands, articles of export, metropolises, ports and sea-routes, and the great traveller's understanding of their significance. It is indeed remarkable that the errors are comparatively few, considering the enormous number of persons and places he mentions. Doubts have been expressed regarding the genuineness of two of his journeys, to Bulghar lands (Kuban area and lower Volga) and to China. But, perhaps the best argument for belief is found in the depth of his keen geographical observations. His description of the Kuban steppes with horses more than the number of sheep in Morocco, and their herding by keepers with the help of lassoing,[1] makes a realistic scene. Speaking of the land to the north beyond the left bank of the Volga he refers to its intense winter cold, the thick mantle of snow covering the ground, the use of dog-drawn sledges as the only means of communication, and the skins of sable, minever and ermine used in trade.[2] In the account of his return journey from Constantinople through S. Ukraine he once more speaks of the intense cold, saying that he had to wear three fur coats and two pairs of trousers, and adding that while he was making his ablutions with hot water close to a fire, the water ran down his beard and froze. In connection with the Chinese travels he speaks of the use of coal when he says, " They make fires with stones which burn like charcoal, and when they are burned to ashes, they knead these with water, dry them in the sun, and use them for cooking again until they are entirely consumed."[3] Further, he remarks that China

1. Gibb : *Ibn Baṭṭūṭā*, p. 115.
2. *Ibid.*, pp. 150-51.
3. *Ibid.*, p. 169.

was the best cultivated country in the world and that there was not a spot in the whole extent of it that was not brought under cultivation. If Marco Polo can refer to the city of Hangchow as being within a hundred-mile compass and possessing twelve thousand bridges of stone, then Ibn Baṭṭûṭa's remark that it took three days to traverse it does not savour of too much impossibility !

He gives an excellent description of the numerous small coral islands in the Maldive group enclosing atolls, and the low level surfaces of these islands. He points out the immense utility of the coconut, palm, and the multifarious uses of all of its parts, recognises cowries to be the shells of animals, and comments on the abundance of fish and the rice cultivation of these coral islands and tropical shores. He also mentions the peculiar dress, manners, and customs of the people[1]. Similarly, along the East African Coast he describes the produce of betel-nuts, bananas, coconut, palms and the import of rice from India.

Ibn Baṭṭûṭa's sea voyages and references to shipping reveal that the Muslims completely dominated the maritime activity of the Red Sea, the Arabian Sea, the Indian Ocean, and the Chinese waters. Also it is seen that though the Christian traders were subject to certain restrictions, most of the economic negotiations were transacted on the basis of equality and mutual respect. People of either religion were taken as passengers on ships without animosity, as Ibn Baṭṭûṭa himself travelled on Genoese and Catalan ships.

1. Gibb : *Ibn Baṭṭūṭā*, pp. 243-44.

Ḥâfiẓ Abrû (Shihâb al-Dîn 'Abdullah b. Luṭfullah al-Rashîd al-Khwafî) was a friend and companion of Tîmûr. He is remembered as a noted Persian historian and geographer who died 833 A.H./1400 A.D. According to Barthold he was commissioned by Shâhrukh about 817 A.H./1414-15 A.D. to write a geographical compendium based upon the older Arabic works, probably Balkhî and Iṣṭakhrî.[1] The work is divided into two volumes, having a cosmographical introduction in the first part. Later follow descriptions of various lands from the West to East (Maghrib to Kirmân). The portions on the regional geography of Khurasan and Ma Wra al-Nahr, unfortunately, remain untraced. Though as a compiler Ḥâfiẓ Abrû incorporated much material from works which have since been lost, it is claimed by a competent critic like Barthold that for the events and conditions of his times the pertinent sections of the work remain an authority of the first rank. The writer was no armchair geographer as he had himself widely travelled and gained information from personal observation. The work is entitled 'Zubdat al-Tawârîkh.'

'Abdul Razzâq (Kamâl al-Dîn b. Isḥâq al-Samarqandî) was born in Herat 816 A.H./1413 A.D. and died there in 887 A.H./1482 A.D. He figures prominently as a Persian historian who has had the benefit of a diplomatic career. He went to India as an ambassador, returning in 1444 A.D. after a three-year stay in the East. On his return he wrote his 'Maṭla' al-Sa'dain wa Majma' al-Baḥrain.' Parts of this work are based on Ḥâfiẓ Abrû's writings but all in all, it can be said to be one of the

1. *Encyclopaedia of Islam*, Vol. II, p. 213.

most important and original sources of information for geographical knowledge during his times. Among the later writers may be mentioned the great scholar produced by India, Abu'l Faḍl 'Allâmî (born in Agra 958 A.H./1551 A.D.), one of the bright lights of Mughal age in the time of Akbar the great. His 'Âin-i-Akbarî' (in Persian) was written to incorporate many-sided contemporary knowledge as viewed by the writer. The geographical references include a description on traditional lines based upon 'climates' and a general survey of the Indian geographical scene[1] with detailed accounts of Mughal Ṣûbahs (provinces). It remains an indispensable source for reconstructing the historico-geographical picture of the hey-day of Mughal times. Apart from its philosophical and general academic merit, a parallel for which is hard to find in the contemporary West, the work has been favourably compared for its patience and industry to modern productions in the field of statistical science and tabulation of resources.[2]

Amîn Aḥmad Razî was a native of Ray and came from a well-known family of men of letters. He was a first cousin of Mirzâ Ghiâth Beg, father of Nûr Jahân who later became the Vazir of Akbar with the title of I'timâd ad-Dawla. There is evidence of Razî having visited India during Akbar's time as he speaks of the great Emperor in the present tense and wrote a detailed account of India from the earliest times to his day and added a special chapter on the history of the Deccan.

1. '*Âin-i-Akbari* (tr. Jarret), Vol. III, pp. 7-9. Also *Animal and Plant Life*, pp. 114-122.

2. *Ibid.*, Translator's Preface, p. 1.

His geographical writings consist of the book with the title of 'Haft Iqlîm' (Seven Climates) which deserves a high place. It is a topographical, historical and biographical encyclopædia.[1] Information is presented on the basis of 'climates.' Under each country or town is found an account of the place, its history, wonders and curiosities and chief products. It is regarded by some scholars as the best and the first encyclopædia in Persian to be arranged on a geographical plan. The work later became very popular. For the geographical portion among his sources Razî mentions Khurdâdhbih, Balkhî, Yâqût and Mustawfî. The work was completed in 1002 A.H./1593 A.D.

With the rise of the Turks and later their political predominance over large parts of Western Asia and South-eastern Europe, Turkey became the source of Muslim geographical writing onward from the middle of the fifteenth century A.D. This literature has many aspects, *e.g.*, cosmographical, descriptive, travel and oceanographic. An interesting feature is the availability of European views on geographical matters and their fusion with earlier Arabic geography and contemporary eastern knowledge which was attempted by Muslim geographers at this period. State patronage is indicated in the interest shown by early Ottoman rulers who encouraged these geographical activities, *i.e.*, manuscripts of earlier geographers were collected, copies made and maps prepared. This explains the richness of Constantinople public libraries in this respect.[2]

1. *Haft Iqlim*, Preface, iv.
2. Kramer's *Encyclopaedia of Islam*, Sup. No. 2, p. 71.

Apart from the translations of earlier cosmographical works and descriptive writings (including, Qazwînî, Abu'l Fidâ, Ibn al-Wardî, Al-Iṣṭakhrî and Ptolemy's Geography, etc.) there were several independent efforts to sum up the geographical knowledge of the time. Among the treatises on geography may be mentioned Muḥammad b. 'Umar b. Bâyazîd al-'Âshiq's 'Manâẓir al-'Âlam' (Description of the World) which was written at Damascus in 1598 A.D. The work was based upon the author's personal journeys as well as information derived from older writings and contemporary knowledge. Next came the 'Geographical Encyclopædia' (Kashf aẓ-Ẓanûn 'An Asâmî al-Kutb wal Fanûn) of Ḥâjî Khalîfah (Muṣṭafâ b. 'Abdullah) also known as Kiatib Chelebî, over which the author spent 20 years in collecting material. He was born in Constantinople in 1017 A.H./1608 A.D. and died there 1067 A.H./1657 A.D. The work draws not only on older works but as well as Muḥammad 'Âshiq, Admiral Sidî 'Alî and Pîrî Raîs but also takes note of European thought, including Mercator's 'Atlas.'[1] Barthold[2] considers it the first attempt to compare the data of European geographical literature with that of the Muslims. In the category of travel literature may be pointed out Mir'at al-Mamâlik, the account of his journey from India to Constantinople by Sidî 'Alî and Auliyâ Chelebî's travel book (Târîkh-i Saiyâh). The later work was based largely upon the personal travels of the author between 1640-1672 A.D. throughout the Ottoman Empire, Europe and Persia. It is devoid of influence of European geographical ideas

1. Kramer's *Encyclopaedia of Islam*, Sup. No. 2, p. 71.
2. Barthold : *Mussalman Culture*, p. 140.

and for the completeness and many-sidedness of information is of a high order. The cartographic attempts of Pîrî Raîs including the copy which he made of Columbus' last map and Sidî Alî's 'Oceanography' (Al-Muḥîṭ) remain outstanding among the contemporary works on geographical matters. The tradition of Turkish geographic-*cum*-descriptive and regional writing was continued down to the close of the last century.

Advancement of Geographical Conceptions

The foregoing account dealing with the contributions of geographers throughout the Islamic world reveals the astounding growth of a geographical literature through several centuries. Its spirit and content quite often display serious attempts at interpretation and scientific reasoning which no doubt was backed up by a vast expansion of knowledge about the world. But it was not only in the field of descriptive and regional geography that such remarkable advances were made, alongside various aspects of physical geography also received attention. There were many investigators who took up matters connected with meteorology, oceanography and physiography.

One of the most interesting scientific works of the fourth century Hijra, the most fruitful in the history of Islamic civilisation, was the 'Ikhwân aṣ-Safâ,' a collection of treatises written by the foremost rationalists and scientists of the day, who preferred to remain anonymous and mostly worked at Baṣrah as an academy or society of learned men. These remarkable tracts include numerous references on current geographical conceptions and ideas which are explained at length

for popular understanding. The compilations as a whole cover the entire field of contemporary knowledge and the expositions were meant to provide a rationalist basis for religious belief.

For example[1], the 'Brethren' explain the eclipses of the sun and the moon with reference to their shadows, the march of seasons by the apparent movement of the sun and conceive of the earth as a globular body. They say that between the lowest celestial sphere and the earth lies the atmosphere which sur rounds the globe. And that the water of the seas becomes vapour and ascends into the air to form cloud masses which are driven by the winds to the mountain summits and there condense and fall as rain, so that much of this water drains into the rivers[2]. Their first physical treatise deals with meteorology and begins by describing the atmosphere. It is said to consist of three layers, (1) the highest of intensest heat called 'aether', (2) the middle one intensely cold, known as 'zamharîr' and (3) the 'nasîm', nearest the earth but of moderate temperature. It is emphasised that though the layers are distinct but it is possible for air to interpenetrate. After the treatise on meteorology follows the section on the composition and formation of the minerals and geological processes are explained. Especially attention is devoted to the work of denuda tion and then the phenomena of earthquakes and volcanic action are mentioned. Botany and plant geography and the zoological habitats of animals (in howsoever an imperfect form) do not escape attention[3].

1. These references are found mostly in *Rasa'il*, I and II A good summary is given in the *Sociology of Islam*, by Levy, Vol. II pp. 370-94.
2. *Ibid.*, pp. 379-80.
3. *Ibid.*, pp 391-96.

Vast geological changes and gradual working out of geomorphological process are also discussed. They declare: 'That as mountains are built up in the ocean depths, the seas rise and overflow plains and steppes until in the course of time the plains become seas and the seas dry land. Upon the land raised out of the sea, rain falls and streams are formed which bring down soil and sand. In this plants, herbage of various kinds and trees grow.'

Mas'ûdî is often remembered as a descriptive geographer but here and there in the course of his works, including the 'Murûj al-Dhahab' he discusses his information and ideas on physical geography. He believed in round earth with a jacket of atmosphere. He proceeds to give a discourse on the stormy nature of the Persian Gulf, Arabian Sea and Indian Ocean and describes the blowing of the monsoon and the peculiar storms of those seas. His mention of the timings of navigation dependent upon these seasonal winds is remarkable and he goes on to point out that such peculiar knowledge is acquired by theory, practice and experience by the sailors of those waters and adds that most Muslim navigators can tell by certain signs and indications the approach and character of storms.[1] Mas'ûdî explains the ebb and flow of tides as well as the boars.[2] He points out that in one of his important works 'Akhbâr az-Zamân' which consisted of thirty parts, he had discussed the origin of seas, their extent, salinity, tidal movements and cycle of river erosion. Evaporation, condensation and insolation do not escape his notice.[3] Animal life in the sea is also

1. Murūj, tr. Sprenger, p. 270. 2. *Ibid*, pp. 272-78.
3. *Ibid*, pp 300-03.

mentioned when he gives a description of the whale Al-Awa'l and Al-Shak (shark?) and says that in the sea of the Zanj (E. Africa) are many-shaped species of fish, aquatic animals, serpents and other strange creatures.

Among other writers on these matters, reference has already been made to the ideas of the great Al-Bîrûnî, while his contemporary the philosopher 'Alî Ibn Sînâ (died 1037 A.D.) also discussed many physiographical aspects and Abû Ma'shar was no mere astronomer.

On the other hand study of environmental influences and the beginning of human geography are also witnessed. It appears[1] that the ideas of some Greek writers like Hippocrates on the influences of environment, early attracted the attention of several Arabic writers on history, medicine, cosmography and geography and they point out the validity of natural surroundings and the operation of facts of natural causation. The celebrated writers on medicine especially studied this relationship between human health, physical characteristics and geographical environment. Touches of such treatment are found in Jâhiz's 'Kitâb al-Ḥaiwân', Ibn Sînâ's 'Al-Urjuzatu's—Sinaiyya,' Maqdisî, Mas'ûdî, Al-Bîrûnî, Qazwînî and Abu'l Qâsim Sa'îd.

But the culmination of such an approach in the study of human history is reached in the method of Ibn Khaldûn (Abû Zaid 'Abdur Rahmân b. Muḥammad b. Muḥammad Walî-ud-Dîn at-Tunisî al-Ishbilî) who was born at Tunis on 27th May, 1332 and died on 17th

1. See 'Ināyatullah : *Geographical Factors in Arabian Life and History*, pp. 2-6.

March, 1406. After having travelled widely in Spain and North Africa and occupying responsible political and administrative posts in Andalus and Egypt he began his literary career at the fairly advanced age of 50 years, when he produced his 'Universal History' (Kitâb al-'Ibar) and its remarkable introduction (Muqaddimah). He was undoubtedly the greatest historical thinker of Islam. It is to the above-mentioned introduction (Prolegomena) that geographers turn with interest and amazement. He is rightly regarded by many scholars[1] as a pioneer of social science and his attempts at the correlation of environment with human activity contained in the chapters of the Prolegomena entitle him to be called the forerunner of the later development of human geography and sociology in the nineteenth century. His geographical accounts are placed at the beginning, for the proper understanding of sociology and history. In the words of Hozayen : "He attempts to trace effects of both climatic conditions and local environment upon the physical and mental qualities of different peoples." [2] He treats the whole subject very much like a modern writer, severely criticising Mas'ûdî and censuring Bakrî for failing to understand the true meaning of history. Sprenger[3] rightly said that Ibn Khaldûn not only wrote history with sound criticism and imagination but also combined ethnography and geography with it.

Ibn Khaldûn also inaugurated an elementary classification of different modes of life, by distinguish-

1. Enan : *Life and Work of Ibn Khaldūn*, pp. 170-72, and pp. 187-88 Also Hell, *The Arab Civilization*, pp. 93-94.

2. Hozayen : Some Arab Contributions to Geography,—*Geography*, 1932.

3. Sprenger's tr. *Murūj*.

ing between what he calls 'Bâdya' (بادیا)—land of nomadic life—and 'Ḥaḍar' (حضر)—land of settled life. To this study he adds many remarks on the type of habitats in 'Bâdya' and the geographical influences, which give rise to the development of the 'city.' He criticises[1] the early Muslim Arabs for founding many cities and townships in utter disregard of adverse geographical environment of hydrographic disadvantages, which neglect, he points out, ultimately led to the quick decline of many such cities, *e.g.*, Qairawân, Kûfah, Baṣrah, etc., as soon as the political patronage had disappeared. He also discusses the growth of industries and the development of exports and imports and examines the characteristic features of the highly efficient agriculture of Andalusia[2] (S. Spain) under the Muslims. It is in such remarks, which are scattered here and there in the Introduction, and are in most cases suffused by his sociological studies, that the interest of his work lies, as a prototype of modern 'human' and 'social' geography.[3]

1. Ibn Khaldûn, (*Prolegomena*) 'Factors Governing the Foundation of Cities.'
2. *Ibid.*, 'Prices in Cities.'
3. See Hozayen, 'Some Arab Contributions to Geography,'—*Geography*, 1932.

CHAPTER III

CARTOGRAPHY

On the other hand, the Arabs were not very successful in attaining high standards in cartography (the science of map-making), one of the causes, of course, being the Arab love of decoration. In many cases the picturesque was preferred to the accurate. But it should not be forgotten that their contributions were made at a period when Western cartography was little more than an attempt to provide theological texts with decorative illustrations, while the Muslim world carried on the tradition of classical achievements and in many respects advanced beyond it. Though their works drew inspiration from Ptolemy, most of the Arab geographers did not follow him slavishly as their knowledge of geography had advanced much further. In general, the representation of the world on a map shows a return to the older Greek and Babylonian conceptions of an encircling ocean. But this was due to the wider maritime activities of the period, which brought them to the shores of the Atlantic on the one hand and to the Pacific on the other. They discarded Ptolemy's idea of the connection between Africa and South-Eastern Asia, making the Indian Ocean a landlocked sea. Nevertheless it is true that in several works facts and fiction are found curiously mixed up.

Throughout the Middle Ages there existed a close relationship between the extension of maritime activity

and navigation and the development of cartographic skill and information. Due to an amazing ignorance, many European writers (some orientalists being an exception) assume that navigational tradition first developed around the Ægean waters.[1] While the fact remains that long before seafaring developed within the limited compass of the Eastern Mediterranean, what can be called oceanic navigation, had become common with many Eastern peoples, *i.e.*, Indians, Chinese, Arabs and Persians. In fact, European contact with the oceans only began a millennium later with Columbus and Vasco da Gama.

The evidence of deep sea navigation by Indians is writ large in the existence of prosperous Hindu colonies in Malaya, Sumatra, Java, Cambodia, Annam and Champa (Siam) towards the first century A.D. and the later continuation of this cultural contact with Indonesia across the Bay of Bengal. The activity under the Chalukyas, Sri Vijaya kings and the Chola emperors was no less remarkable.[2]

Navigation in the Indian Ocean

The advent of Buddhism in China marked the beginning of their interest in India, Burma and Ceylon. Priests and pilgrims began to visit these countries by land as well as by sea. It is, however, only from the third century of the Christian era that authoritative records of Ceylon are found in Chinese literature. Two important Chinese travellers, Fa-hsien (399-414 A.D.) and Huien Tsiang (629-45 A.D.) have left records of their journeys. The return journey of Fa-hsien *via*

1. Panikkar: *India and the Indian Ocean*, pp. 22-23.
2. Ibid., pp. 32-33.

Ceylon and across the Indian Ocean proves the existence of the maritime connection with China, but there is little evidence of their trading activity by sea. They were mainly engaged in exchanging goods with the Arabs who had founded settlements of their own all around the shores of Southern Asia and South-eastern Asia waters up to Sumatra, Java and the Moluccas.

Persian navigators of the Arabian Sea and the expedition against Ceylon belong to the times of Noushîrwân, about early sixth century A.D.

Then towards the middle of the seventh century A.D. dawned a new day for the Arabs with the rise of Islam as a great spiritual, social and political force. Within a hundred years of the death of the Prophet they became the masters of a mighty empire greater than that of Rome. Their domination of the seas extended from the two basins of the Mediterranean, down the Red Sea to the known lengths of the Indian Ocean. Here history presents us some strange and interesting facts. In the West the Muslims held sway along the western, southern and the eastern regions of the Mediterranean and had possession of several islands there. The Red Sea was virtually an 'Arabian Lake.' In the Indian Ocean, however, their direct political control did not extend in the east beyond the coastal areas of the lower Indus. Yet we find the strange spectacle of numerous Arab settlements with the full enjoyment of their religious and social practices, along the Konkan, Malabar and Coromandal Coasts, in the Maldives and Ceylon, and their commercial activity extended to the Andamans, the Nicobars, the Arakan Coast, Malaya, Sumatra and

Java. Islam had come to these regions without any political help whatsoever and remained rooted to the soil for centuries, away from the turmoils of Maḥmûd's invasions of India and the struggle between the Cross and Crescent in the world of the West. Here trade or religion did not follow the flag, as they most certainly did a few centuries later with the rise of European commercialism. The Arabs' predominance in the trade of these waters was based upon their sense of adventure and capacity to sail over the seas. This along with the simplicity of their religious belief, earned for them the amiable and friendly treatment of vast non-Muslim elements in this Eastern world. The extensive Arab historico- geographical literature dealing with this corner of the world gives us a revealing picture of these peaceful commercial relations. There is not a single instance of discord between the Muslim and the non-Muslim rulers or peoples culminating in war. Then appeared the Portuguese, heralding the advent of European commercialism in the Indian Ocean. History tells us of the bitter struggle[1] that these Westerners had to wage not only against the Arab and Muslim elements but against the common hostility of Muslim and non-Muslim alike. The peoples of Malabar, the Maldives and Ceylon with their Muslim friends offered the utmost though unavailing resistance.

Conditions of Navigation in Surrounding Waters

In the days of Arab navigation the wind and weather were a much more important factor and the accompanying cyclones a greater menace than in our days

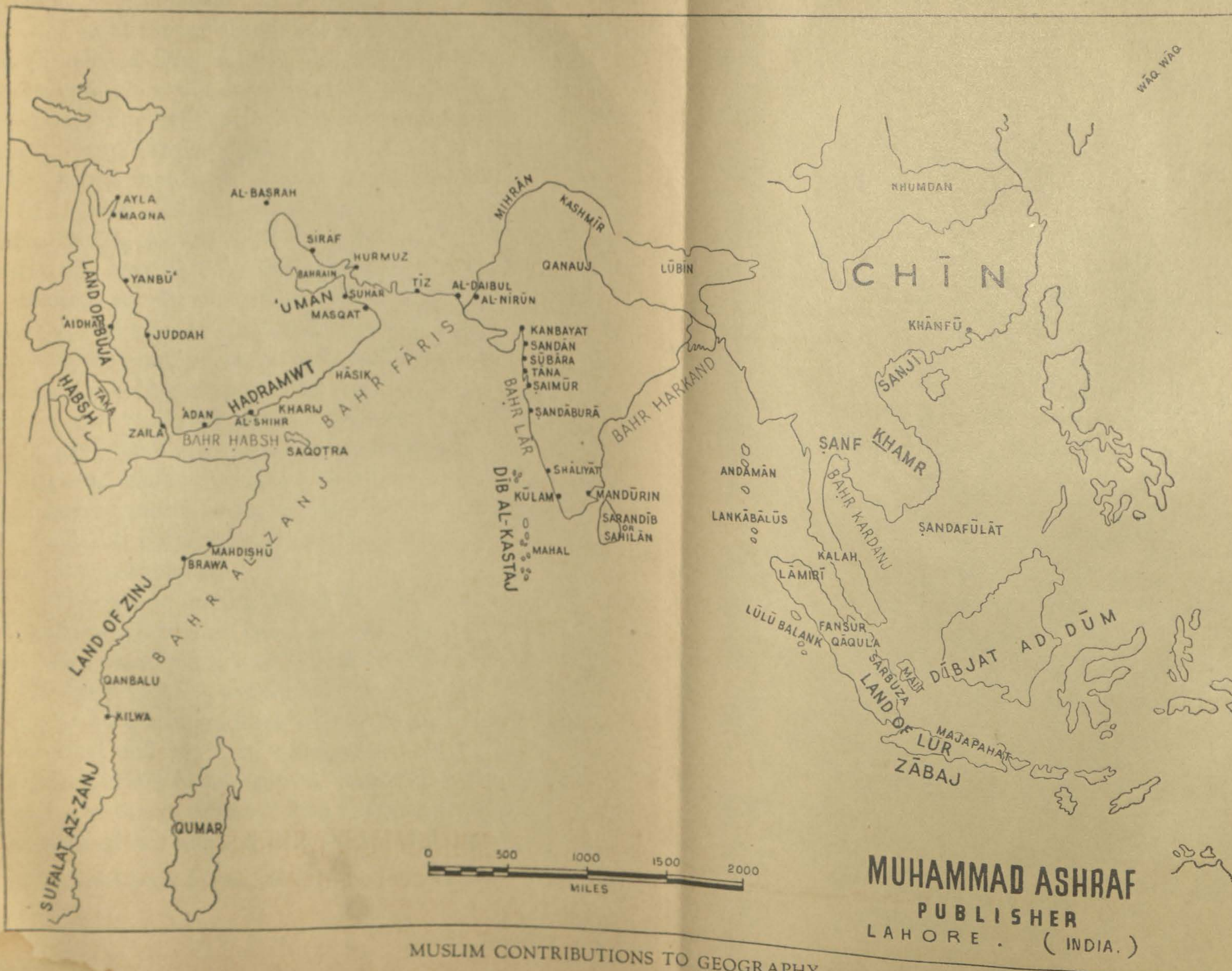
1. See Shaikh Zainuddin's *Tuḥfat-al-Mujāhidīn*, for a detailed picture of this protracted struggle.

of steam. The sailings were directly influenced by the change of seasons. The monsoon brings with it the rainy season with frequent squalls and dirty weather. There is a succession of cyclones following the trend of the monsoon, and therefore sailings over the Arabian Sea and the surrounding waters, northward or southward, depended on the direction of the monsoon. The uncertainty of weather associated with cyclones and their great speed,[1] especially north of the Equator, averaging five to nine miles per hour between 11 degrees N. to 200 N. Lat., made the sailings round Ceylon no holiday cruise for generations of those brave Arab sailors. The invention of the compass by them[2] was of tremendous importance, and the compass remained the guide of navigators whose destination was Ceylon, the Sunda Islands, or the China Seas. The perfection of the astrolabe was also put to common use in sailing. The lack of other precise instruments such as we possess today was made up for by long experience of wind and weather handed down from generation to generation. Many Arab writers like Sulaimân Tâjir, Abû Zaid, Buzurg Ibn Shaharyâr and Mas'ûdî have spoken about these conditions. But the peak of Arab knowledge of these waters was reached on the eve of the advent of the Portuguese. To this period belong the valuable works of men like 'Aḥmad ibn Mâjid (Kitâb al-Fawâ'id, 1489-90) and ' Sulaimân al-Mahrî ' ('Ulûm al-Baḥriyah, early sixteenth century). It is a legacy of this knowledge that

1. S. Rogers : *The Indian Ocean*, p. 169.

2. Regarding the controversy about the invention of the compass seen by the present writer, ' Muslim Contribution to Astronomical and Mathematical Geography,' *Islamic Culture*, Hyderabad, Vol. XVIII, No. 2, April 1944. Also *infra* Chap. IV.

INDIA, EAST AFRICA AND FAR EAST
AS KNOWN TO THE ARABS FROM 8TH TO 14TH CENTURY. A.D.



many of the commonest terms in modern meteorological terminology are of Arabic origin. *e.g.*, typhoon for Ṭûfân (طوفان), monsoon from Mausim (موسم), etc.

The earlier of the above-mentioned works was that of Shihâb al-Dîn Aḥmad b. Mâjid who wrote sailing instructions for the Indian Ocean, Red Sea, Persian Gulf, Western China Sea and South-eastern Asia waters. Mâjid[1] was born at Julfar in Arabia and came from a well-known family of seamen and navigators. He was at Malindi (E. Africa) when Gama arrived there and the latter having succeeded in securing his services as escort and guide was able to sail across to Calicut in 1498. It is related by Barros that this 'Mu'allim' (expert in navigational matters) showed Vasco da Gama a map of the whole coast of India arranged with meridians and parallels. Gama showed him the big wooden astrolabe and others made of metal. But on seeing these the Arab navigator expressed no surprise and informed the Portuguese leader that down that part of the world they used better instruments as well as took guidance from the stars and then showed the Europeans an instrument made of three plates.

The period during which Ibn Mâjid published his 30 nautical texts lies between 1462 and 1489-90. The most important work was 'Kitâb al-Fawâ'id' (Principles of Navigation, etc.) concluded in 1489-90. The book seems to be a compendium of the known knowledge of theoretical and practical navigation. It deals with the legendary origin of navigation, lunar mansions, magnetic needle, sea-routes of the Indian Ocean and the latitudes of a number of harbours in that ocean and the China Sea.

1 See *Encyclopaedia of Islam*, Vol. IV, p. [illegible]65 *et seq*. (Article by G. Ferrand.)

In addition, it describes the West Coast of India, the ten large islands (Qumr or Madagascar, Sumatra, Java, Al-Ghûr or Formosa, Ceylon, Zanzibar, Bahrain, Gawan and Socotra, etc.), the monsoon with dates of commencement either ways, and ends by mentioning in detail the anchorages, shallows, banks and reefs of the Red Sea. G. Ferrand rightly remarks: "We must regard it as a kind of synthesis of nautical science of the later years of the Middle Ages. Ibn Mâjid is at the same time the earliest of the modern writers of nautical guides. His work is admirable. The description of the Red Sea, for example, has never been surpassed or even equalled . . . . The information given on the monsoons, local winds, routes and latitudes for crossing the whole Indian Ocean, are precise and detailed as could be expected at this period."[1] The work of Mâjid was of such usefulness that his memory was still alive in the Maldives and along the Indian littoral in the first half of the nineteenth century. As late as the middle of the same century there is record to show that people sailing out of the Red Sea into the vast expanse of the Indian Ocean used to sảy 'Fâtiḥa' in honour of Shaikh Mâjid.[2]

Sulaimân b. Aḥmad b. Sulaimân al-Mahrî who was a younger contemporary of Mâjid wrote five treatises in prose on sailing instructions about the first half of the sixteenth century, of these the third 'Al-'Umdat al-Mahriyah fi' ḍabt al-'Ulûm al-Baḥriyah' has chapters on nautical astronomy, sea-routes in the Arabian Sea, East African

1. *Encyclopaedia of Islam*, Vol. IV, p. 365.

2. G. Ferrand, Introduction, *a L'stronomie Natique*, p. 228. For influence of Mājid's ideas on European navigation see Hubert Bird, *The Arab Navigators*, etc., (in Arabic) in *Al-Mustama' al-'Arabi* B.B.C., London, 21 August, 1943, pp. 12-13 and 18.

waters, Bay of Bengal and Malayan and Indo-China Coasts, routes along a large number of Indian Ocean islands, monsoons of the Indian Ocean in detail and some outstanding voyages are also described.[1] Mahrī's work was translated by Sidī 'Alī ('Alī b. al-Ḥusain—d 1562), the Turkish Admiral who wrote his 'Muḥīṭ' in 1554. A little earlier Pīrī Raīs had written an oceanographic work on the Mediterranean (Baḥriyah) in 1523 and supplemented it with maps of all parts of the coast of that sea.[2] Another writer of this category was Al-Sifaqsī ('Alī b. Aḥmad b. Muḥammad al-Sharqī) whose work was written in 1551.

The remarkable Portolano charts came much later in the day, the earliest examples dating from about 1300 A.D. But the perfection found therein is difficult to account for unless we assume a long process of evolution.[3] The majority of Western scholars, however, are of the opinion that the Portolani are unconnected with any other series of maps, medieval or classical. Perhaps some new discovery helped by later research may reveal the influence of Arab navigation charts on these European maps. In spite of their many fine details, the makers of these charts did not use Ptolemy's system. They neglected latitude and longitude because they were difficult to determine, hence their grid system was merely a series of lines radiating, like the spokes of a wheel, from several points on the map.

The Babylonian conception of the universe figured a disc-shaped earth floating in the ocean, with the vault

1. *Encyclopaedia of Islam*, Vol. IV, p. 529.
2. *Ibid.*, Sup. No. 2, pp. 70-71.
3. Jervis : *The World in Maps*, p. 69.

of the heaven arching above it, and the firmament over all. This notion was accepted by the Greeks and Romans, as well as by the Israelites, and through the Scriptures it was carried over to the Christian Europe of the Middle Ages. Ptolemy marks the culmination of cartography in the ancient world. Henceforth there was a steady decline. Although the 'Geographia' continued to be available in the Arabic world, it disappeared in Western Europe and was not recovered until the fifteenth century. As a result the Latin-Germanic culture of the Middle Ages was forced to depend for its geographical knowledge on an inferior source, the tradition of Roman cartography. Ptolemy's most fundamental error was his underestimate of the earth's size, an error which luckily helped to strengthen Columbus' belief that he would reach Asia quicker by sailing westward. Taking the figures of Posedonius (1 degree=500 stadia) and applying them to the distance measurements at his disposal, he concluded that Europe and Asia extended over one-half the surface of the globe, while in reality they cover only about 130 degrees. Similarly he reckoned the length of the Mediterranean as 62 degrees, whereas in reality it is only 42 degrees. "Although the Arab geographers and the marine chart-makers of the thirteenth century had corrected this distortion, it continued to figure in European cartography until 1700."[1]

On the whole, from the point of view of a distinct advance over the older works, the Muslim geographers constructed celestial globes and studied the problem of

1. Raisz : *General Cartography*, p. 21, See also Philby in *Rozgar-i-Naw*, p. 31.

projections. Their maps of those areas which had come under Islam were superior to those of Ptolemy. And a progressive tendency was that maps were regularly used for geographical instruction in schools.

One of the earliest map-makers was Al-Khwârizmî. His 'Kitâb Şûrat al-Arḍ' was written in explanation of maps. It is surmised that his map was copied from a Syrian copy of Ptolemy's map. It did not show a network of latitudes and longitudes. He also made a map of the Nile. According to the view[1] which accepts Khwârizmî's participation in the scientific activity of Mâmûn's period, he was connected with the joint production of the famous map made for the Caliph, in which no less than seventy scholars participated. Some orientalists[2] have hinted that perhaps there had existed a collection of maps of some parts of Iran and a world map in pre-Abbasid times, which may be called an 'Iran Atlas'. To indicate the possibility of such a collection it is pointed out that Ibn al-Faqîh mentions a map of Dailam, made for Ḥajjâj and Balâdhurî says in 'Futûḥ al-Buldân' that in support of a petition to the Caliph Al-Manṣûr a map of the canals of Baṣrah was attached.

The next stage is reached with the advent of what can well be called the 'Balkhî school.' Balkhî's Atlas contained a world map, a map of Arabia, the Indian Ocean (Baḥr Fârs), maps of the Maghrib (Morocco, Algeria, etc.), Egypt, Syria, the Mediterranean (Baḥr Rûm), and about a dozen other maps of the central and eastern Islamic world. The text of his geographical work which described the various lands, divided into

1. Minorsky : '*Ḥudûd al-'Alam* (Barthold's Preface, x).
2. Kramers : *Encyclopaedia of Islam*, Sup. No. 2, p. 65.

'climatic' zones, was written in explanation of his maps. K. Miller in his 'Mappae Arabicæ' fittingly calls it the 'Islam Atlas'. All that is lost, but Iṣṭakhri and a little later Ibn Ḥawqal continued this method of supplementing their writings with maps which were largely based upon Balkhi's labours. But the originals of these attempts do not survive to enable us to judge fairly of their merits. Maqdisi represents the closing stages of the Balkhi school. He says, "In the making of maps we have done our best to bring out correct representations of the different parts of the empire after carefully studying a number of drawings . . . . and also the drawings of Ibrâhim al-Fârisi (Iṣṭakhri), which come nearer to fact and are worthy of reliance although confused and imperfect in many places.[1] He divided the Muslim world into fourteen divisions and showed each one in a map. And a proof of his more practical cartographic ideas is found in his own words: "In these maps the familiar routes have been coloured red; the golden sands, yellow; the salt seas, green; the well-known rivers, blue; and the principal mountains drab; that the descriptions may be readily understood by everybody." [2]

Al-Birûni made a round map of the world in his 'Kitâb al-Tafhim' to illustrate the position of the seas and in another work 'Chronology of Ancient Nations,' he devised a method for the projection of maps of the sky and the earth. Idrisi was undoubtedly a celebrated map-maker, who is said to have made seventy maps of his 'Climatic' divisions, a celestial sphere, and a globe of silver,—on the globe he indicated his seven latitudinal

1. Maqdisi, p. 8 (Constantinople MS.).
2. Ibid., p. 12.

'climatic' divisions. He also made a world map on a silver plate. These were prepared along with other geographical works at the court of his patron King Roger II of Sicily towards 1154 A.D. His maps indicate the western Islamic world better than eastern. Later world maps of Qazwînî and Al-Wardî were perhaps designed after the world map of the 'Balkhî school'. Two celestial globes were made by 'Abdur Raḥmân al-Ṣûfî towards 1040 A.D. in Cairo, and Ibn Hula of Mawṣul made his bronze globe in 1275 A.D. A round world map is found in the Constantinople MS. of Al-Kâshgharî's 'Dîwân Lughat al-Turk' (1333-1335 A.D).

The painstaking researches of Konard Miller and Prince Youssouf Kamal with the collaboration of J. H. Kramers now make it possible to arrive at a fair estimate of Muslim cartography.[1]

1. *Monumenta Cartographica Africae et Aegypti.*

CHAPTER IV

ASTRONOMICAL AND MATHEMATICAL GEOGRAPHY

The Muslim contributions to the astronomical and the mathematical side of geography were a part of that broader intellectual and scientific movement which commenced with the Abbasid age. Its growth and development can best be followed in relation to the four chief schools, *i.e.*, those of Baghdād, Egypt, North Africa, and Andalusia. In addition, after the decline of the central authority of the Caliphate at Baghdād, these scientific traditions were followed in the east, first at the court of the new provincial dynasties (particularly, the Buwaiḥids and the Ghaznavids), and later under the new-born intellectual zeal of some of the Mongol princes.

THE BAGHDAD SCHOOL

On the culmination of the age of conquest the Muslims had become masters of many of those territories which had served in the past as the cradles of civilisation and culture—Mesopotamia, Persia, and Egypt; while the conquest of Syria and Palestine early brought them into contact with the Nestorians who had been exiled from the Roman lands on account of their 'heresy.' Thus Greek knowledge and ideas were available to the Muslim world at an opportune moment when conquest and expansion were giving place to peace and culture. Simultaneously the arm of Islamic expansion had reached the border-lands of Indian culture, and there is evidence

of considerable contact with the cultural trends beyond the Indus in the comings and goings of embassies and the visits of learned individuals. From India came two works of special importance from our point of view, the 'Brahma-sphuta-Sidhanta' (better known to the Arab world as Sind-Hind) and Khanda-Khadyaka (known as Årkand—آركند)[1]. An Indian astronomer and mathematician, Brahmagupta, had composed both these works towards 628 A.D. and they were brought to Baghdâd in 154 A.H./771 A.D. Indian scholars helped in the translation of these works by Al-Fazârî and Ya'qûb ibn Ṭâriq. A later influx of Hindu learning in the same direction was the intellectual influence exercised by the ministerial Barmak family, under Harûn ar-Rashîd. The Iranian sources also did not go unnoticed and the famous Pahlavî Tables (Zij ash-Shaharyâr—royal astronomical tables) compiled during the last days of the Sassanids, were translated from Persian by Abu'l Ḥasan. In the sense of time the Iranian and the Indian influences were earlier than those of Greek origin, Al-Fazârî's 'Kitâb az-Zij' (tables), compiled in the second half of the eighth century A.D., reflects Indian influence and the 'Cupola' of the earth is spoken of as 'Arin,' which according to Kramers is a false reading of Ujjainî (Ujjain) and points to this early contact[2].

However, with the advent of Al-Mâmûn the real scientific age of Islamic culture begins. In the intellectual sense the many-sided influences had already penetrated deep into Muslim society. Then, above all, the weight of Mâmûn's personality and liberal patronage

1. Datta and Singh : *History of Hindu Mathematics*, Part I, p. 83.
2. *Encyclopædia of Islam*, Sup. No. I, p. 63.

of learning was harnessed to the advancement of science along with that of all branches of learning. The great Translation Bureau بيت الحكمة Bait-ul-Ḥikmat had already been established under Hârûn ar-Rashîd, where were employed learned translators of all nationalities and creeds—Hindus, Parsis, Christians, Jews, Muslims[1]. Books and extant material were collected by Mâmûn from all countries regardless of cost, and translators were paid the weight of books in gold[2]. The liberality of this enlightened prince in the promotion of knowledge was remarkable indeed. He is said to have asked the Byzantine emperor to send the savant Leo to Baghdâd in return for five tons of gold and an offer of permanent peace between the parties[3]. Among the translators employed at the 'Bait-ul-Ḥikmat' four were outstanding: Ya'qûb al-Kindî, Ḥunain b. Isḥâq, Thâbit b. Qurra, and Al-Baṭrîq. There were also two well-known Hindu translators, Mankah and Ibn Dahan (also Doban), who knew Arabic.

The majority of Arabic geographical authors based their work more or less on the 'Almagest' (Al-Majisti) المجسطي and the 'Geography' of Ptolemy. The first translation of the 'Almagest' by Nairîzî was of great consequence. Since Ptolemy himself had given a mathematical and an astronomical bias to his labours, his admirers followed the tradition. Therefore the work of the astronomers, as far as it has bearings on Geography, is also to be taken into consideration, if we are to grasp the full

1. Shibli: *Al-Māmūn*, p. 164.
2. *Ibid.*, p. 170.
3. *Ibid.*, p. 175.

meaning of Muslim contributions. Thus an outline of their work has been provided.[1]

The first series of regular observations with accurate instruments were conducted at Jundi-Shâpûr (S. W. Persia) during the first half of the ninth century, and were utilised by Aḥmad al-Nahâwandî and resulted in the preparation of his 'General Tables' (az-Zij al-Mushtamil) 803 A.D. But with the systematic work of translation in the reign of Mâmûn and the establishment of observatories at Baghdâd and Damascus begins the real work on geographical matters. The great Caliph was not satisfied with the progress made by the Translation Bureau, and he allotted much greater resources to it and gathered together all the known workers in the scientific field.

Ya'qûb al-Kindî, who knew many languages and has written no less than 282 books, was the next noted translator of Greek works. The astronomers and mathematicians embodied their labours in the so-called 'Verified Tables' (az-Zij al-Mâ'mûniy al-Mumtaḥan) which were prepared among others by Yaḥyâ b. Abi Manṣûr, Sind b. 'Alî and Khâlid b. 'Abdul Mâlik al-Marwarûzî. These tables do not exist in their original form. The measurement of a degree of latitude entailed difficult geodetic operations[2], but this was done with a remarkable approach to accuracy in about latitude 36 N,

1. *The History of Arab Mathematics*, by Dr. 'Aṭâul Ḥakim, Professor of Mathematics, Islamia College, Calcutta, which has been accepted as a thesis for the degree of Ph. D. by the University of Calcutta, contains useful biographical information.

2. The method undertaken will be described fully in its proper place in the section dealing with measurements.

as a result of simultaneous observations between Tadmur (Palmyra) and Raqqa, the result being a little more than the actual, *i.e.*, by 2,877 feet.[1] Other findings in the verified tables relate to the obliquity of the ecliptic, the precession of equinoxes, and the length of the solar year, etc. Among these early astronomers was also Mâshâ' Allâh son of Athârî or Sariya (b. 112 A.H./730 A.D., d. 200 A.H./815 A.D.), who made his own instruments and took careful observations. Khwârizmî had prepared an abridgement of Sind-Hind, and Al-Kindî who was well-versed in Greek did much useful scientific work relating to interpretations of the Alexandrian school. Another notable figure was Abû Ma'shar (Ja'far b. Muḥammad b. 'Umar), a native of Balk, who is known to Europe as Albumasar. He was a student of Al-Kindî and died at Wâsiṭ at the ripe old age of a hundred years (272 A.H./886 A.D.). Europe mostly knows him as an astrologer and there has grown up a tendency to belittle his astronomical work. But his tables (Zij Abû Ma'shar) deserve a high place. He was specially interested in celestial phenomena. Al-Mâhânî studied the eclipses of the sun and the moon and the conjunction of the planets, etc., about the year 854-68 A.D., but unfortunately his works are not to be found beyond scattered references here and there.[2]

1. Nallino : *Encyclopædia of Islam*, Vol. I. p. 498.
This statement refers to the result discussed later in this chapter, where it is stated 'but adopted the larger of the two values *viz.* 56 2/3 miles.' It should be noted that by the word mile here is meant the Arabian mile, not the English. 1 Arabian mile = 6472.4 English feet. The circumference of the earth equal to 20,400 miles mentioned in this chapter is also reckoned in Arabian miles. Its value in English miles would be 24847.2. Taking the degree of latitude near the equator as equal to 68.7 miles (English), the circumference comes out as nearly 24,732 miles. See a discussion on this subject in *Hyderabad Academy Studies*, No. 3, p. 108 (article by Prof. Mohd. A. R. Khān), entitled 'Need for better Co-operation between Oriental Scientists and Ārabic Scholars.'
2. *The Hākimite Tables* of Ibn-Yūnus.

The labours of the three sons of Mûsâ b. Shâkir, *viz.*, Muḥammad, Aḥmad and Ḥasan, occupy an important place among the works of the school of Baghdâd. From 850 to 870 A.D. they were engaged in the metropolis taking observations from their State-patronised observatory at Bâb aṭ-Ṭâq (the Ṭâq Gate) on the Tigris. Their tables were greatly relied upon by Ibn Yûnus. Al-Baṭṭânî did his work at Raqqa from 877 to 918 A.D. and died in 929 A.D. Sedillot[1] thinks that European writers have attached undue importance to his works owing to their ignorance of the contributions of his predecessors. He says that Baṭṭânî played the same role among the Arabs as Ptolemy did among the Greeks, as both produced the sum-total of knowledge acquired till their time. Baṭṭânî's tables have been entirely lost and the Latin versions are full of mistakes. Thâit b. Qurra (d. 288 A.H./813 A.D.), a Christian savant at the Court of Baghdâd, translated the 'Almagest' afresh. Ḥabash al-Ḥâsib worked at Baghdâd about 300 A.H./912 A.D.

With the weakening of the authority of the Abbasid Caliphs onwards, much of the work of these astronomer-geographers centres round the Buwaihid Court, and in this connection the name of Ibn al-'Âlam (d. 375 A.H./988 A.D.) is of note as the author of 'tables' based upon independent observations relating to the determination of the precession of equinoxes in an exact manner with the help of self-made instruments. But there is no trace of his work. He is reputed to be a teacher of 'Aḍad-ud-Dawla. 'Abdur Raḥmân as-Ṣûfi

1. *L'Histoire des Arabes.*

(d. 376 A.H./986 A.D.), the famous author of 'Aṣ-Ṣuwar al-Kawâkib ath-Thâbita' and writer of a book on the astrolabe, Abu'l Qâsim 'Abdullâh al-Colûzî and Ja'far were among the contemporaries of Ibn al-'Âlam. Al-Râzî (Abû Muḥammad b. Zakariya, 840-902 A.D.), the famous Rhazes of the West, wrote on the form of the earth (Kitâb Ḥai'at-al-'Âlam) and contributed a treatise on the setting of the sun and planets (Risâlat fî-Ghurûb ish-Shams-wal-Kawâkib). He was born at Rayy and worked at Baghdâd. The Buwaihid Court in the days of 'Aḍad-ud-Dawla and Sharaf-ad-Dawla was surrounded by a galaxy of astronomers, mathematicians and other savants. Among the rest, three more names figure prominently for their contributions on geographical matters. Al-Kûhî' (Abû Sahal al-Waighân b. Rustam d.1004 A.D.) was the designer of many instruments and the founder of the observatory at Baghdâd under Sharaf ad-Dawla. Kûhî's works are lost, although he is credited with the observation of the summer solstice and of an autumnal equinox.[1] Abu'l Wafâ (Muḥammad b. Muḥammad b. Yaḥyâ b. Ismâ'îl b. 'Abbâs) was born in Buzjân in Khurâsân between Herat and Nishâpur in 995 A.D. and died 998 A.D. He observed the obliquity of the ecliptic in 995 A.D. and prepared his 'tables' (Zij Shâmî). It is said that he was struck by the imperfection of the lunar theory of Ptolemy and on verification pointed out a third inequality which was no other than the one that was discovered by Tycho Brahe six hundred years later.[2] Abû Muḥammad al-Khujandî in 992 A.D. made and used his own instruments. Hârûn

1. Sedillot : *L'Histoire des Arabes.*
2. *Ibid.*

b. 'Alî, maker of astronomical instruments, and his new 'tables' and Abû Isḥâq are other names that shed glory on the achievements of the Baghdâd school.

About this time the ever-increasing chaotic political conditions and the waning prestige of the Caliphs brought to an end this great scientific activity at the metropolis. The most important feature, however, of the Baghdâd school was the truly scientific spirit which had been the guiding principle of all its workers. These savants always worked from the known to the unknown, and experiment and demonstration were the foundations of their system.

Egypt

By the end of the tenth century Egypt had already broken loose from the Caliphate of Baghdâd, and its capital was destined to become a new centre of scientific activity. The reigns of Al-'Azîz and Al-Ḥâkim were the golden age of this school. Al-'Azîz (375 A.H./996 A.D.) founded the observatory at Cairo and rich endowments were allotted to it by Al-Ḥâkim also. The outstanding work was that of Ibn Yûnus (Abu'l Ḥasan 'Alî b. Abi Sa'îd 'Abdur Raḥmân b. Aḥmad b. Yûnus), who died in 399 A.H./1009 A.D. He made a series of observations at his observatory on Mount al-Muqaṭṭam from 367 A.H./977 A.D. to 389 A.H./1007 A.D. Ibn Yûnus was certainly a worthy successor of Abu'l Wafâ and also relied greatly upon the labours of the three sons of Mûsâ b. Shâkir. As a result of his careful observations and measurements he produced the famous 'Ḥâkimite Tables' (az-Zij al-Ḥâkimî), which succeeded both the 'Almagest'

and three earlier treatises of the school of Baghdâd. Because of their authenticity these tables ultimately found currency in distant lands such as Persia, Mongol domains, China, and mediæval Europe. In addition, Ibn al Haithâm (d. 430 A.H./1039 A.D.) was another noted mathematician and physicist who did much outstanding work.

Al-Bırūnī.—In point of time as well as from the view-point of far-reaching significance in the advancement of all aspects of geographical knowledge, stands out at this stage the dominating figure of Abû Raiḥân Muḥammad al-Bîrûnî. He is certainly one of the greatest intellectuals of all times.

Much of his geographical work has already been discussed,[1] and here only an outline of his contributions to the astronomical and the mathematical side of the subject will be provided. He combined in himself the understanding of all aspects of geographical thought and in this respect, above all else, he measured up to the standard of Ptolemy: in many ways he even surpassed the Alexandrian. He possessed the tremendous advantage of being well-versed in several languages, *i.e.*, Greek. Syriac, Persian, Arabic and Sanskrit. On his arrival in India with Sultan Maḥmûd, he devoted himself whole-heartedly to the study of Sanskrit with a view to getting access to the best sources of Indian thought, including mathematics, astronomy and chronology. He studied many Indian works including Brahmagupta's and among the Arabians all his great predecessors,

1. *Supra*, Chap. II.

including Al-Fazârî, Ya'qûb ibn-Ṭâriq, Khwârizmi, Kindî Abû Ma'shar and Jaihânî. In the opinion of a worthy scholar,[1] his work represents a scientific renaissance in comparison with the aspirations of the scholars working in Baghdâd under the first Abbasids Al-Bîrûnî devoted a life-time to the service of science and learning. According to Yaqût, there were only two days in the year, Nauroz and Meharjân, when he used to leave off his intellectual pursuits, otherwise his hand never left the pen.[2] He himself discussed the attitude of the real scientist in an admirable way in his introduction to 'Qânûn al-Mas'ûdî' القانون المسعودی.[3] Al-Bîrûnî wrote no less than fifteen books and dissertations on topics like the measurement and determination of latitudes and longitudes, finding of distances and co-ordinates of the Ka'ba. Instruments and their uses were discussed in no less than five booklets giving various methods of constructing astrolabes, etc. In all, he was the author of several dozen books of which a large number dealt with geographical matters. Information about these books is obtained from some of his own great books, *viz.*, 'Chronology of Ancient Nations' (Al-Âthâr al-Bâqiyah) الآثار الباقیه, 'Indica' (Kitâb al-Hinḍ) کتاب الہند and 'Canon Masudicus' القانون المسعودی and from Ḥâjî Khalîfa's 'Kashf al-Zanûn 'an Asami al-Kutb wa'l Fanûn' کشف الظنون عن اسامی الکتب والفنون (An Encyclopædia).[4]

Al-Bîrûnî's astronomical and mathematical labours are largely collected in his 'Canon Masudicus,' a monu-

1. Sachau : *Al-Birûnî's India* (Preface, xxvii),
2. *Ma'jam Al-Udaba*, Vol VI, pp. 308-9.
3. Barni : *Al-Birûnî*, pp. 232-33.
4. For details see Barni's *Al-Birûnî*, Chap. IV, and Sachau : *Kitab al-Hind* (Arabic text).

mental work written in 1038 A.D. at Ghazni and dedicated to Sulṭân Mas'ûd. It still awaits full translation and publication. Besides, he also refers to astronomical, mathematical and geographical matters in his other works, e.g., 'Indica' and كتاب التفهيم لاوائل صناعت التنجيم Kitâb at-Tafhîm al-Awâil Ṣanâ'at al-Tanjîm (a sort of introduction to astrology) and the 'Chronology of Ancient Nations.' In the domain of mathematics his labours are of a far-reaching character.[1] Certainly Al-Bîrûnî can be regarded as one of the greatest geographers of all times. His services to geography were manifold and immense. He much developed the mathematical side of it, carrying on geodetic measurements and determining with a remarkable precision the co-ordinates of a number of places. He introduced a simple method of stereographic projections. In addition, he explained the occurrence of natural springs and artificial wells (artesian) by the laws of hydrostatics.[2] Geology and mineralogy also did not escape his attention. He discussed the earth, its axis and its movements, and threw much light on the Hindu methods of determining latitudes and longitudes. His contribution to the general geography of India[3] was also of a high order.

To this period also belongs a notable contemporary of Al-Bîrûnî, Abû 'Alî Sînâ (Abû 'Alî al-Ḥusain b. 'Abdullâh b. al-Ḥusain b. al-'Uṭâ ash-Shaikh ar-Ra'îs Abû Sînâ) 980 A.D. to 1036 A.D., known to the West as Avicenna. Along with Al-Bîrûnî and others he was

1. Ziā-uddin Aḥmad, Opening Speech, 12 Math. Conference, Aligarh, December 1941.

2. G. Sarton : *Introduction to the History of Science*, Vol. I, p. 870.

3. See by the present writer, "Al-Birūni's Geography of India", *The Calcutta Geographical Review*, March and December, 1943 (Appendix I).

among the galaxy of savants at the Court of Khwârizm before Sulṭân Maḥmûd's conquest overwhelmed it. He was celebrated for his philosophic discourses as well as for his skill in the practice of medicine, but physics and astronomy were no ordinary pursuits with him. 'Târîkh Ḥukamâ' contains a list of forty-one books by him, which included treatises on astronomical instruments (copy of MS. in the Vatican), the place of the earth in the universe, heavenly bodies, and their uses, in answer to questions about the characteristics of the equator. He also wrote a compendium of the 'Almagest'.[1] Ibn Sînâ's treatise on minerals remained one of the chief sources of geological knowledge in Western Europe until the Renaissance.

SPAIN

Like the eastern lands of Islam, Spain was also the cradle of this scientific activity, and Cordova, Seville, Toledo and Granada shared the honours from the middle of the tenth century A.D. onwards. Unfortunately many works have been lost, and in many Latin and Spanish works compiled under Alphonso X (1252-1282 A.D.), which are indebted to Muslim sources, either due recognition has not been given or names and subject-matter have been badly distorted.

Maslama al-Majrîtî (d. 398 A.H./1007 A.D.) made a synopsis of the tables of Al-Baṭṭânî which were later made much use of by the authors of the 'Tables Alphonsine.' A very well-known name is that of Az-Zarqalî (Arzachel), who lived and worked towards the second half of the eleventh century A.D. (1029-1088) and was the

1. 'Aṭaul: *History of the Arab Mathematics.*

author of the 'Toledo Tables'. He was also the maker of many instruments, including astrolabes. Latin translations of some of his treatises are preserved in the Bibliotheque Nationale, but unfortunately the originals have been lost.[1] Other authorities were Jâbir b. Aflâh (Geber) of Seville (d. between 1140-50 A.D.), and Ibn Rushd (Averroes), d. 1198-99 at Marrakush and born at Cordova 520 A.H. The last named famous philosopher and scientist wrote a book on the motion of the heavens and an epitome of Ptolemy's 'Almagest.' Ibn Bâjjâ (Avempace) d. 553 A.H./1129 A.D. and Al-Bitrûjî (Alpetragius) d. 600 A.H./1204 A.D. are among other Spanish writers on our subject. On the whole the Ptolemaic findings were disputed in Spain and many corrections were attempted.

North Africa

This part of the world of Islam also did not remain aloof from this universal scientific activity. Tangier, Ceuta, Fez and Morocco shared in this work and their scholars show an indefatigable ardour. Among them the most celebrated was Abû 'Alî al-Ḥasan b. 'Umar al-Marrakushî, who produced his astronomical works about 1230 A.D. He travelled from the heart of Spain through a large part of North Africa and discovered the altitude of the pole in forty-one cities.[2] His book (Jâmi'al-Mabâdî wa'l Ghâyât) is entitled "The Beginning and the End," and has been studied by the eminent scholar, M. J. J. Sedillot.[3] He was also the author of a treatise on astronomical instruments. His

1. Sedillot : *L'Histoires des Arabes.*
2. *Ibid.*
3. *Ibid.*

work has been characterised by an eminent scholar[1] as "the most important contribution to mathematical geography—not only in Islam but anywhere . . . . It includes among other things the co-ordinates of 135 places, the observation having been made by himself in 34 of them. No mediæval writer has taken equal pains to explain scientific methods and instruments."

PERSIAN AND THE EAST

During the Saljûq period some useful work was done at the court of the powerful Sulṭans. The reign of Jalâl-ad-Dîn Malik Shâh (1072-1092 A.D.) was outstanding; he surrounded himself with notable astronomers and gave his name to the Jalâlî era which came about as a result of the reform of the calendar under the guidance of men like 'Umar Khayyâm and 'Abdur Raḥmân. Rayy and Nishâpur were the chief centres of this scientific activity.

Though later the Mongol inundation swept remorselessly over the fair lands of Islam, yet in a short while the victors submitted to the intellectual superiority of the conquered. Hulâgû Khân (d. 1265 A.D.) collected at his court the leading astronomers and mathematicians. The most illustrious among these was Naṣîr ad-Dîn aṭ-Ṭûsî, the famous author of the 'Ilkhânî Tables'. A magnificent observatory was set up at Marâgha, near lake Urmiah in modern North Iran. Aṭ-Ṭûsî collected all the great available works from Khurâsân, Baghdâd, Moṣul and Syria. At its full height the work lasted for twelve years, and with it were associated many astronomers, including Najam ad-Dîn

1. G. Sarton : *Introduction to the History of Science*, Vol. II, pp. 41-42.

Qazwînî, Mu'ayyad ad-Dîn, Muḥî ad-Dîn, Fakhr ad-Dîn and others. Though the tables of Ibn Yûnus were the basis of the Ilkhani Tables, they were reproduced with many modifications. Aṭ-Ṭûsî's pupil Quṭb ad-Dîn Maḥmûd ash-Shîrâzî continued his work. A suggestion has been made that there were also Chinese scientists working under Naṣîr ad-Dîn, and that may perhaps explain the influence of Muslim scientific thought upon China at this epoch[1]. The last bright phase of the work is associated with the activity in the rising city of Samarqand. Ulugh Beg (796 A.H./1393 A.D.—853 A.H./1449 A.D.), grandson of Timur, summoned the leading lights—Jamshed al-Kâshî, Qâḍî Zâde Rûmî, and Mu'în ad-Dîn Kâshânî to his court, and the Tables (Zîj-i-Jadîd Sulṭânî), the preface to which was written by himself, truly represent the last stage in the glorious traditions of the school of Baghdâd.

Establishment of Observatories

As would be expected, the collection of such vast scientific data and the production of outstanding treatises were linked up with the establishment of up-to-date and well-equipped observatories, sometimes subsidised by the rulers but often also set up by the nobility and members of the aristocracy for their scientist friends. No sooner had beginnings been made with the cultivation of the sciences, as a result of the cultural contracts with non-Arab elements, than the observatory of Jundi-Shâpûr came into existence in the first half of the ninth century A.D. It was a small town in Khûzistân (S. W. Iran), founded by Shâpûr I, the Sasanian, and

1. G. Sarton : *Introduction to the History of Science*, Vol. II, p. 14.

later inherited the traditions of scientific work in the days of Anûshîrwân (550 A.D.). Today the site is marked by the ruins of Shahâbâd. At this observatory worked men like Aḥmad an-Nahâwandî, the compiler of 'Zij-al-Mushtamil' (General Tables, 803 A.D.). The instruments used are said to be very accurate. In the days of Al-Mâmûn the most celebrated observatory was that of Shamasyâ in the plains of Tadmur (Palmyra), established in 216 A.H. Mâmûn appointed Yaḥyâ b. Abî al-Manṣûr, Khâlid b. 'Abdul Mâlik Marwârûzî, Sind b. 'Alî and 'Abbâs b. Sa'îd Joharî and several other mathematicians and astronomers from all the four corners of the realm as directors. Observations were conducted with the help of the latest and most accurate instruments.[1] There was another state-owned observatory on Mount Qasiyum, two miles north of Damascu·. These and other observation stations were under a board of astronomers[2] headed by Yaḥyâ b Abî al-Manṣûr, and the data thus collected resulted in the preparation of the famous 'Verified Tables' A little later, in 235 A.H., Ad-Dinâwarî (Abû Ḥanîfa Aḥmad b. Dâ'ûd) built his observatory at Isfahan, where he made observations recorded in his 'Kitâb ar-Raṣad'. Then he probably went back to his little home-town (Dinâwar in Persian Iraq) where his observatory was pointed out for several centuries later. Ad-Dinâwarî was also a noted botanist and wrote a scientific book on the subject, 'Kitâb an-Nabât'. He died in 282 A.H./805.[3] Reference has already been made to the observatory at Bab aṭ-Ṭâq (Ṭaq Gate) on the Tigris, in Baghdâd, where

1. Shibli : *Al-Māmūn*, p. 174 (quoting from *Kashf as-Zanūn*).
2. 'Aṭāul Ḥakim : *History of Arab Mathematics*
3. *Encyclopædia of Islam*, Vol. I, p. 977.

the sons of Mûsâ b. Shâkir did such useful work. The Ṭaq Gate was at the eastern end of the bridge taking the Khurâsân road across the Tigris. It opened directly into the great market-street east of Baghdâd from which the chief thoroughfares branched.[1] Later, Sharaf ad-Dawla (988 A.D.) made an observatory at Baghdâd which was situated in the garden of his palace. The instruments that were used were made by As-Ṣâghânî, an outstanding instrument-maker of his age. Here worked two noted scientists, Al-Kûhî and Ab'ul Wafâ.

Ibn Yûnus' work was largely carried on at the observatory of Al-Muqaṭṭam. The observatory was built on the part of the range of hills which lies immediately east of Cairo and reaches a height of about 600 ft. overlooking the Nile. Both Al-Ḥâkim and Al-'Azîz spent large sums of money in equipping and maintaining this observatory.

In the later period, in the east, two observatories attained a wide fame and both were the result of the patronage of science by Mongol princes. Hulâgû Khân fixed his residence at Marâgha, 50 miles from Tabriz as the crow flies. The city was situated in a valley overlooking a fertile plain stretching up to lake Urmiah, nine miles away. On the plans submitted by his Vazir, Naṣîr ad-Dîn Ṭûsî, he erected a great observatory on a fortified hill west of the town. Today only traces of the foundation walls are to be seen. The observatory was fitted with many instruments. "The rays of the sun were admitted through a perforation in the dome so as to strike upon certain lines on the

1 Le Strange : *Baghdād during the Abbasid Caliphate* p. 178.

THE ARAB NAMES IN THE MEDITERRANEAN LANDS IN MIDDLE AGES



pavement, in such a way as to indicate, in degrees and minutes, the altitude and declination of the sun in every season and to mark the time and hour of the day throughout the year. On a big terrestrial globe were traced the inhabited regions, outlines of the oceans, rivers, lakes, islands, together with the descriptions of climatic conditions and various zones.[1] Ṣadr-ud-Dîn 'Alî b. ash-Shujâ' is said to have been the superintendent of the observatory and Ṭûsî had appointed four advisers, one of whom was a noted astronomer of the town, Fakhr ad-Dîn. In addition to instruments the observatory had a well-equipped library containing about 400,000 books.[2] Lastly, Ulugh Beg built his observatory at Samarqand on the other side of the Kûhî. It was so big and well-equipped that it was regarded as one of the wonders of the world.[3] Jamshed al-Kâshî was the first superintendent of this observatory. The prince himself was a practical scientist and used the observatory. The Emperor Bâbar, in his autobiography, says that he had seen the ruins of the observatory at Samarqand.[4] Here was prepared 'Zij-i-Jadîd Sulṭânî.'

Instruments in Use

Such scientific work, as well as various other measurements and observations, would not have been possible without the use of many instruments of precision. Of course, some of these were earlier inventions, but they had undergone a great deal of improve-

1. 'Aṭāul Ḥakim, *History of Arab Mathematics.*
2. Jurji Zaidān : *'Ulum-i-'Arab*, p. 227.
3. *Encyclopaedia*, Vol. IV, p. 905.
4. Maulānā Sulaimān Nadvi, Ziāuddin Uṣṭurlābi Humāyūni, *Ma'ārif* August 1933.

ment. Those which were on the Greek model[1] were the Astrolabe (Uṣṭurlâb) (اصطرلاب). Latercus (al-Libna)—a square graduated plate for reading the distance between two objects—Annulus or Aquinoctialis (al-Ḥalqat-ul-I'tidâliyâ), which was a graduated circular plate fixed at right-angles to the equatorial circle for reading the declination at the meridian, the triad, the sextant and the clepsydra. To these the Arabs added 'Dhât al-Autâr' (four square cylinders so arranged and contrived as to ascertain the time at different latitudes), 'Dhât as-Simt wa'l Irtifâ', al-Mushâbahat bi'l Manâṭiq (an instrument for reading regular distances), 'Ḥalqat al-Kubrâ' and 'Ḥalqat aṣ-Ṣughrâ,' various kinds of sun-dials, and most probably some sort of compass,[2] and perhaps other instruments about which we do not know.

Before the invention of the telescope, the microscope, and the vernier, there can hardly be said to have been instruments of precision. But necessity is the mother of invention, and since there was the need for land-measure, for levelling and measurement of heights, the world developed several interesting instruments. In general, ancient surveyors measured distance by the use of a rope or a wooden rod. The unit of measurement varying in different localities. They laid off right-angles by the use of an instrument resembling the carpenter's square of the present day.[3]

Of all the instruments in use by the Muslim astronomer-geographers the most familiar was the astro-

1. 'Aṭāul-Ḥakim, *History of Arab Mathematics*. (This work is under publication).

2. Still a matter of controversy; will be dealt with presently.

3. Smith: *History of Mathematics*, Vol. II, pp. 344-45.

labe in its various forms. The astrolabe has had a long history among astronomico-mathematical instruments. The word is derived from the Greek α∂Τρου 'star' and λαβαγΣLγ 'to take',[1] since it was an instrument used not only for stellar but also for solar and lunar altitude-taking. The basic instrument can be reduced to three fundamental types, according as they represent the projection of the Celestial Sphere on a plane, or the projection[2] of this projection on a straight line, or the sphere itself without any projection. The astrolabe dates back at least to Hipparchus and perhaps even earlier to Eratosthenes. In many ways it is the forerunner of the modern sextant[3]. It became a favourite instrument with Muslim scientists who effected many improvements on the older model. Firstly, they used a flat instrument, astrolabium planisphærum (Saṭḥi سطحي or Musaṭṭaḥ مسطح), in Arabic also called Dhât aṣ-Ṣafa'iḥ, consisting of tablets. It was a portable metal instrument in the form of a disc, ranging in size from 3.9 inches to 7-8 inches in diameter, and had a handle ('Urwa) through which passed a suspending ring (Ḥalqa, 'Ilâqa), by means of which it could be suspended in a vertical position.[4] As a result of many improvements the Muslim scientists used the astrolabe for finding the height of any star on immediate observation and thereby knowing the hours of day and night already spent; then in addition to solving many problems of spherical astronomy (with which we are

1. *Encyclopædia Britannica*, 13th edition Vol. I p. 793.
2. Nallino : *Encyclopædia of Islam*, Vol. I, p. 501.
3. Dickinson and Howarth : *Making of Geography*, p. 108.
4. Nallino : *Encyclopædia of* Islam, Vol. I, also see Donaldson : The uses of the Astrolabe etc., *Islamic Culture*, January 1945, pp 49-53.

not concerned here) it was useful in undertaking geodetic operations, *e.g.*, for calculating the distance of an inaccessible place, the height of a building, the depth of a well whose diameter could be measured. It is obvious that such a small instrument would not give great accuracy, and especially in the case of observations connected with celestial phenomena where, on account of the precession of the equinoxes and the diminution of the obliquity of the ecliptic, variations occur over a period of time. The astrolabe intended for use in the northern hemisphere was called the 'Shimâlî' and the one for the southern hemisphere the 'Janûbî'. The one which was called the 'perfect' (Kâmil) had additional marking to show the circle of the sun's equation. It was only the advent of the telescope, the modern sextant, and the theodolite which gave precision to our observations and measurements. In fact, till the seventeenth century the mariners went on using the astrolabe for the direct measurement of the altitude of the sun.

In the course of time Europe learnt about the perfected astrolabe from Arabian sources, and on account of its utility it became known as a 'Marvel of Convenience and Ingenuity' and was also called the 'Mathematical Jewel'.[1]

It is not intended to provide a history of astrolabe-making, but some of the outstanding makers of this instrument and writers on the subject may be mentioned in passing. Among the earliest makers of the astrolabe among the Muslims were Al-Fazârî (d. 796 A.D.) and Al-Nairîzî (d. 922 A.D.). Al-Khâzin wrote a book on it, 'Kitâb Zij aṣ-Ṣafâ'iḥ.' Al-Khujandi (d. 382 A.H./992 A.D.),

1. *Encyclopaedia Britannica*, 13th edition, Vol. I, p. 795.

who lived in the Court of Fakhr ad-Dawla the Buwaihid, constructed an instrument known as 'Sudas al-Fakhri,' (some kind of astrolabe), by means of which latitudes of places were found out. It has been called the forerunner of the modern sextant.[1] Al-Jilli (971-1029 A.D.) also wrote a book on the astrolabe. In the observatory of Sharaf ad-Dawla at Baghdâd, towards 1000 A.D., were two famous instrument-makers Aṣ-Ṣâghânî and Rustum al-Kûhî. Al-Bîrûnî was not only a great writer on instruments in use, *e.g.*, in several Risâlas[2] on 'Uṣṭurlâb' and the 'Kitâb at-Tafhîm'[3]: among others he mentions Al-Khujandî, his friend and contemporary Abu Sa'îd as-Sinjarî (maker of a big astrolabe), and Al-Jillî; but he himself was no less an inventor of many instruments. In the West Az-Zarqalî (1029-1088 A.D.) was the outstanding maker of astrolabes and his 'Safiha' exerted the most far-reaching influence on the use of the improved astrolabe in Europe. Mathematicians, astronomers, sailors and mariners remained familiar with it for several centuries. Later, in the East, Badî' az-Zamân (d. 1139-40 A.D.) Uṣṭurlâbî was the most efficient astrolabe-maker of the time. He also constructed a celestial sphere and globe, among other instruments. Muẓaffar al-Ṭûsî is known for his 'Aṣâ'i Ṭûsî' and Al-'Urḍî was the most celebrated of the instrument-makers of the Marâghâ observatory. It is said that he was the supervisor of a foundry and tool-shop which was attached to the observatory. He was in all probability the author of a treatise describing the

1. Barni : *Al-Bîrûnî*, p. 12 (see footnote).
2. *Ibid.* (also see *Al-Bîrûnî's India*, Arabic text edited by Sachau).
3. Sarton : *Introduction to the History of Science*, Vol. II, p. 12.

instruments used at Marâghâ. Among other instruments he was the maker of a Hipparch's diopter (alidade) and parallactic rulers (after Ptolemy)[1]. It is also surmised that at this observatory they also had instruments with which they could distinctly perceive remote objects (maybe, a sort of miniature telescope).[2] The continued use and construction of good instruments is evident in the days of Ulugh Beg at Samarqand. Very late in the day, the craft spread to India, where onwards from Humâyûn's time the family of Ḍiâ-ud-Dîn Uṣṭurlâbî constructed many astrolabes through three or four generations[3].

Religious and astronomical interest made it incumbent upon the astronomers to lay particular stress upon the accurate determination of the geographical latitudes and longitudes of places. Above all, the precise knowledge of latitudes was used in the construction of horizontal sun-dials ('Baseta') which, like the town clocks in our own time, always adorned the open squares where there was usually a mosque. These sun-dials were constructed with regard to the latitude of a particular place.[4] It is a legacy of those times that in many mosques today along with a clock inside we find sun-dials adorning the court-yard.

1. Sarton : *Introduction to the History of Science*, Vol. II, p. 1013 (here the question of 'Urdi's authorship of the treatise on instruments is discussed and Sarton gives a list of the instruments made by him).

2. According to 'Aṭāul Ḥakim, *History of Arab Mathematics* (quoting from Jourdian).

3. Maulānā Sulaimān Nadvi—Diā-Uddin Humāyūni Uṣṭurlābi, *Ma'ārif*, August 1933.

4. Schoy : "Geography of the Muslims of the Middle Ages," *American Geographical Review*, Vol. XIV, 1924.

The invention of such a useful instrument as the mariner's compass is in some quarters[1] still regarded as obscure, and the claim of originality is divided between the Chinese, Greeks, Etruscans, Finns, Italians and Arabs. The theory of Chinese origin is now largely discredited, as it is pointed out that "the first practical use of the magnetic needle was credited by the Chinese themselves to foreigners, who were in all probability Muslims."[2] The extensive Muslim maritime activity would certainly warrant the use of such an instrument. What has given cause for speculation, however, is the fact that according to some the earliest reference to it outside of China is found in Europe in the Latin writings of Alexander Neckam,[3] but the Englishman does not speak of it as a novelty. Muslim references are said to be later, perhaps for purposes of secrecy mention of the instrument was avoided. But Maulânâ Sulaimân Nadvî[4] asserts that the earliest mention of the 'Quṭb Numâ' is found in Idrîsî's work, who says that it was commonly used among the Arabs. The floating compass and its early popularity with the Muslim sailors of the Indian Ocean is a historical fact, (see 'Jawâmi'-al-Ḥikâyât' by 'Awfî).

Measurement of Latitudes and Longitudes

It should be remembered that methods and instruments for the precise determination of position, *i.e.*, latitude and longitude, are essential to navigation and

1. *Encyclopædia Britannica*, Vols. V-VI, pp. 806-8.

2. Sarton : *Introduction to the History of Science*, Vol. II, p. 629.

3. *Ibid.*, p. 630.

4. For Maulānā's criticism of the views expressed in *Encyclopædia Britannica* and for further details proving Muslim origin see Arab Navigation, *Islamic Culture*, October 1942.

the construction of accurate maps. Generally speaking, latitude may be determined by the measurement of the altitude of the sun, the pole star, or the upper and lower culminations of a circumpolar star. The earliest instrument known for measuring the elevation of the sun was the gnomon (Miqyâs) which consists simply of a vertical rod, from the length of whose shadow the altitude of the sun can be calculated. It is traced back to the Babylonian times. It has often been asserted that in the matter of these measurements Muslim astronomer-geographers in no way surpassed the 'Almagest' of Ptolemy. But such a view is based upon insufficient knowledge of the work done by the Muslim. It has been rightly pointed out that "various Arabic geographers carried out unusually thorough researches leading to the determination of geographical latitudes, and thereby contrived methods as original as the results occasionally were accurate."[1] For example, Ibn Yûnus first called attention to the error resulting in the reckoning of latitude from the shadow of the gnomon, because in this manner errors of as much as 15° creep in, as the shadows are cast from the upper edge of the sun and not from its central point.[2] The early astronomers, Al-Khwârizmî, Farghânî, Ḥabash al-Ḥâsib and Al-Baṭṭânî made use primarily of Greek and Indian methods of finding latitude. But Schoy points out how Khwârizmî hinted at (though he did not apply) the method of the culmination of a circumpolar star. Ibn al-Haitham (965-1038 A.D.) devoted a separate work to the exact calculation of latitude.[3] He recommended the taking of

1. Schoy: *Geography of the Muslims of the Middle Ages.*
2. *Ibid.*
3. *Ibid.*

a bright fixed star for the precise determination of the latitude of the pole. But Al-Bîrûnî came out with much scientific and original suggestion in his masterpiece 'Qânûn-al-Mas'ûdî,' applying the method of circumpolar stars to the sun. His latitude of Ghaznî found by this method was accurate, and he found the latitude of numerous places which are mentioned in 'Kitâb al-Hind,' 'Kitâb at-Tafhîm,' and 'Qânûn al-Mas'ûdî.' Other almost exact calculations were those of the three sons of Mûsâ b. Shâkir at Baghdâd, Al-Mâhânî at Surra-man-ra'a, Ibn Yûnus at Al-Muqaṭṭam, and Ulugh Beg at Samarqand

As far as the determination of longitude is concerned, it was a much more difficult problem until the eighteenth century, for two reasons,—firstly, there was the problem of choosing a prime meridian, secondly, the difficulty of calculating the angular distance east and west of this line. Ptolemy had used the meridian of the Fortunate Isles (vaguely identified with the Canaries) as his standard.

In the determination of longitude the Muslims either began in the farthest west, like the Greeks, and counted through 180° to the east, or sometimes the reckonings were made east and west of an arbitrary prime meridian which at times was supposed to pass through the 'Cupola of Arin' (Qubbat al-Arḍ) lying at the centre of the earth's surface on the equator. 'Arin' was perhaps a corrupt reading of the name of the Indian town, Ujjain. Before Al-Birûnî's time a common method of finding longitude was to make use of the eclipses of the moon. The result was that inaccuracies to the extent of several degrees cropped up. He is said

to have been the first to point out the so-called terrestrial method of calculation. "Having determined accurately the shortest linear distance between the points and the latitudes of each, Al-Bîrûnî calculated the difference in longitude from the data thus acquired. This he did in correcting older figures for the distance in longitude between Alexandra and Ghazna, together with the longitude of a number of intermediate points. This calculation is discussed in a chapter of his famous astronomical geography—'Qânûn Mas'ûdî,' a work comparable to the 'Almagest' of Ptolemy."[1]

The technical procedure of the Arab geographers in determining longitude by the observation of the eclipses of the moon was fully elaborated by Ibn Yûnus.[2] An outstanding improvement as a result of the careful calculations of longitude by Muslims was the correction in the exaggerated length of the Mediterranean Sea, which was a legacy of the Ptolemaic error of no less than 17°.

The Earth: Its Shape, Size, and Movements

The opinion on the sphericity of the earth was divided in the Europe of the Middle Ages; one can find ideas ranging from the absurdities propounded by Cosmas to the hesitation of the Christian mind to accept the pagan views. St. Augustine[3] regarded roundness as incredible. On the whole the question remained highly hypothetical and the mediaeval European mind steeped in ignorance born of religious obscuranticism was not prepared to accept the idea of sphericity, which sounded

1. Schoy: *Geography of the Muslims of the Middle Ages.*
2. In *Ḥākimite Tables*.
3. Sarton: *Introduction to the History of Science*, Vol. II, p. 46.

somewhat paradoxical and fantastic to it. Thus a great deal of unscientific and amusing argument centred round the idea of the antipodes and the human life therein. While on the other hand, in accordance with their scientific attitude, nearly all the Arab geographers believed in the sphericity of the earth, as, according to Honigmann, the Eratostherian theory of climate so fully elaborated by them implied such a belief. The majority, therefore, held to the idea of the earth's being a sphere floating in space. Ibn Rustah summarises these ideas in his 'Work of Costly Treasures.'

As to the size of the earth, much speculation along with serious attempts at measurement had gone on from very early times. Among such attempts the following may be noted with reference to the earth's circumference.

Greek M	... Aristotle 45,964,[1] Eratosthenes 25,000[2].
Posedonius	... 18,000, Ptolemy 18,000
Hindu	... Āryabhaṭa 33,177; Brahmagupta 50,936, Achârya 48,714.

No sooner had Muslim scientific astronomical and mathematical activity begun than geodetic operations engaged the attention of scholars. The first outstanding attempt at the measurement of the earth's circumference was made by Al-Mâmûn's scientists under the supervision of the sons of Mûsâ b. Shâkir in the plain of Sinjar in the Syrian Desert. The method that they adopted was that a number of observers setting out from the same point

1. Results are given in English miles, unless otherwise stated.
2. Geographical miles.

walked some to the north and the others to the south, until they had seen the pole star rise and sink one degree. They had been using a rope and fixing it to pegs, and when it was measured, giving the total distance covered, the mean of the results was taken. They actually did not keep this mean but adopted the larger of the two values, *viz.*, 56 miles.[1] The circumference thus worked out to 20,400 miles. The radius of the earth according to Al-Baṭṭânî and Al-Farghânî was 3,250. Arabian miles and Ibn Rustah put it at 3.818.[2] But once more we find the great Al-Bîrûnî excelling everybody. In Chapter VII of 'Qânûn al-Mas'ûdî' he discusses the question of the circumference of the earth. He undertook measurements in a level plain in Northern Dahistân in Jurjân, but the attempt fell short of success; he therefore brought the task to completion in India by measuring the so-called horizontal depression from a mountain, and the result was 56 miles, 050″. In this connection he very favourably comments on the calculations carried out under the sons of Mûsâ b. Shâkir. The question of the motion of the earth was not discussed in Europe and the planet was considered to be stationary in the centre of the Universe. But many Muslim geographers, *e.g.*, 'Alî b. 'Umar al-Kâtibî, Quṭb ad-Dîn Shîrâzî and the Syrian Abu'l Faraj, doubted the idea of rest and hinted at a daily rotation, though the idea was finally rejected because that involved the complete understanding of the laws of motion, which had to wait for Galileo and Kepler. But

1. Arnold and Guillaume, *Legacy of Islam*, p. 381. But Shibli (see *Al-Māmūn*, p. 173) gives the reading as 66-2/3 miles, quoting *Ibn Khallikān*.

2. *Encyclopædia of Islam*, Vol. I, p. 499.

the very fact that doubts were expressed against Ptolemaic findings showed that the Muslims had a commendable progressive tendency and cleared the way for the Copernican reform in 1543. One wonders how Copernicus' work remained undone in spite of such an advanced scientific outlook.

Al-Bîrûnî, accepting the vague Babylonian and Hindu conceptions believed in the turning of the earth on its own axis. He believed in the movement of the sun round the earth. But being a true scientist he had an open mind and therefore spoke with admiration of the suggestion of Abû Sa'îd Sinjarî regarding the possible movement of the earth round the sun.[1] Later, the question of rotation was taken up by 'Umar al-Kâtibî al-Qazwînî, one of the workers at the Marâghâ observatory, who prepared an edition of the 'Almagest' (d. 1277 A.D.). In his 'Ḥikmat al-'Ain' he introduced the ticklish argument, "If it, *i.e.*, the earth, did not rotate, could a flying bird keep up with it?" Answering[2] he said, yes, because the atmosphere might be turning together with the earth and drag the bird. But he was overpowered by the Aristotelian prejudice against accepting such a revolutionary contention and therefore he was unable to anticipate Galileo and Kepler. He added, "All terrestrial motions take place in a straight line and therefore we cannot admit that the earth should move in a circle."[3] Then among others who took up the question was Quṭb ad-Dîn ash-Shîrâzî (1236-1311 A.D.), pupil of Naṣîr ad-Dîn Ṭûsî. An

1. Maulānā Sulaimān Nadvi : 'Ilm-Jughrāfiyā al-'Arab, *ad-Diā*, January 1933.
2. Barni : *Al-Bīrūnī*, pp, 210-11.
3. Sarton : *Introduction to the History of Science*, Vol. II, p. 764.

important work on astronomical geography was his 'Nihâyat al-Idrâk fi' Dirâyat al-Aflâk' (On the highest understanding of the knowledge of spheres) based on Ṭûsî's Tadhkira, and including discussions on geography, geodesy and meteorology. He discussed the question whether the earth was at rest or not. Shîrâzî too could not go beyond the ruling conceptions about motion and concluded in favour of rest and conceived of the earth as an immobile sphere placed at the centre of the Universe. But the fact that he discussed the problem at lenghth[1] was in itself a healthy sign.

1. Sarton : *Introduction to the History of Science*, , p. 1018.

CHAPTER V

RÊSUMÊ

In the preceding pages the story of the many-sided aspects of Muslim contribution to geography has been related. It was a part and parcel of that new expression of an intellectual renaissance which characterised the rise of Islamic civilisation. Its growth and development is so closely linked with the dawn of a new scientific spirit which so markedly set reason above authority. The Arab's assimilation of both classical and oriental lore and their cementing by their own genius led to a remarkable quickening of the scientific impulse. They were never servile imitators of foreign models. "They possessed a will, a mind, a marked capacity of their own, which impressed its individual stamp on all they received or borrowed from without." This was as true of geographical science as of other arts and sciences. This striking intellectual freedom was amazing indeed, for theirs was an age of faith and blind submission to authority. Throughout the centuries we come across an array of rationalist thinkers and scientists who not only resurrected the classical age but also laid the foundations of experimental science. The spirit of tolerance, large outlook and craving for learning and extending the frontiers of knowledge, which characterised the Muslim mentality, logically followed that attitude of the mind. It is not surprising therefore, that such a psychological make up which permeated the

Mussalman communities never stood in the way of the investigation into the causes of natural phenomena. Thus geographical science during these times was so closely linked with cultural and scientific progress and continued to attract the attention of intelligent people as long as there was a continuity of cultural development or as Stanislas Guyard said, " During the Middle Ages the history of Muhammadanism is the history of civilisation itself [1]."

A view is often held that the Mongol invasion of the thirteenth century dealt a death-blow to Mussalman culture from which it never recovered. Thereafter followed a period of rapid decline as the Arabs and the Persians had already by this time contributed all they could and their successors the Turks were unable to produce any creative work. That such views[2] are based on obvious misconceptions and it has been amply demonstrated by many competent modern historians and orientalists that such a picture of " the Muslim world as plunged in deep sleep till it was reawakened by the Europeans in the nineteenth century is to a great extent exaggerated."[3] The riches and wealth, power and prestige of the Usmanlis, the Timurids, the Kajars and the Grand Mughals in India in their times outshone any part of Europe.

Most modern geographers attach little value to Muslim geographical contributions coming after the thirteenth century and generally dismiss it as a sterile period.

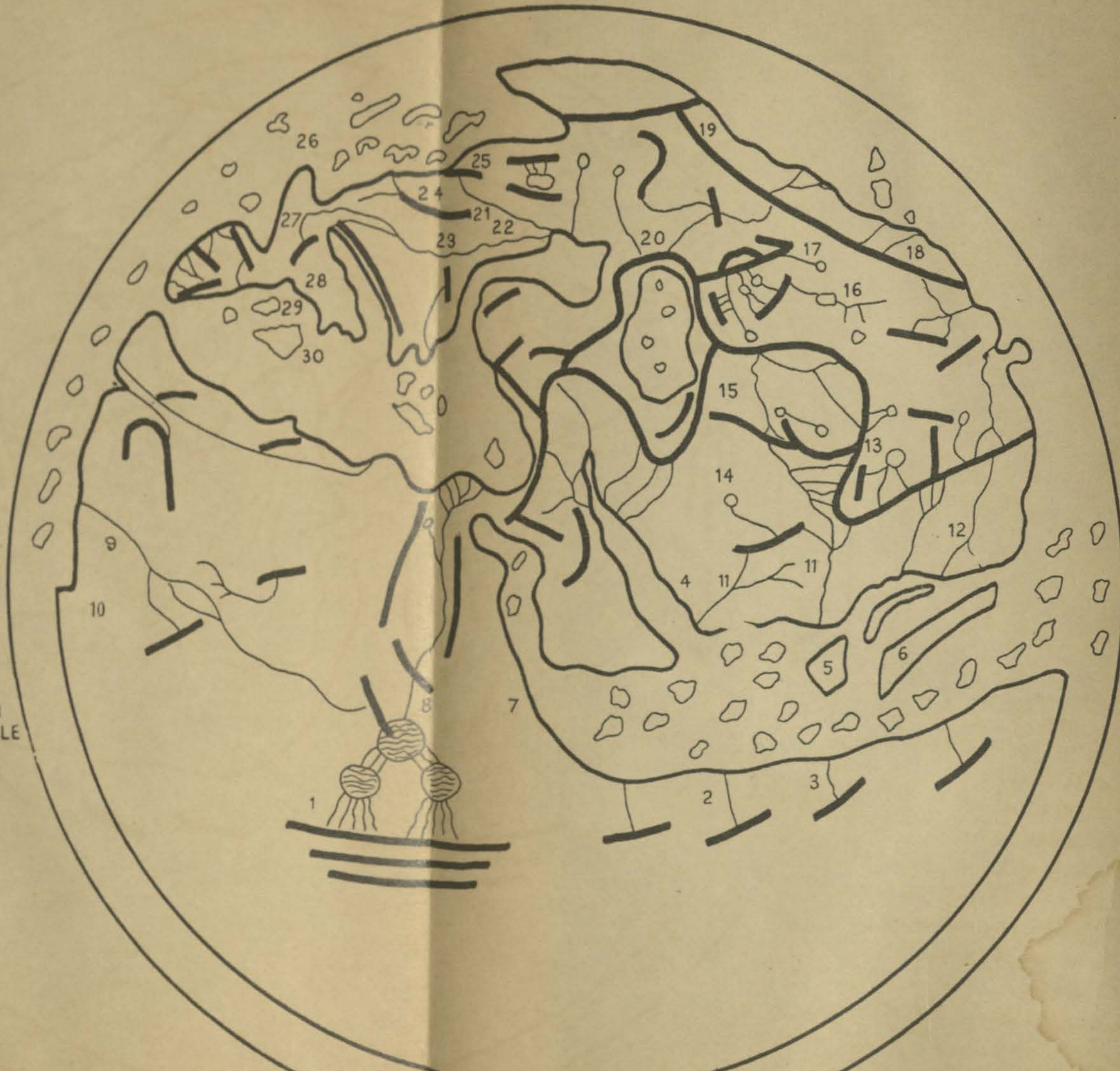
1. Zaki 'Ali' : *Islam in the World*, p. 97.

2. J. Hell : *Arab Civilization*, p. 103 and many others i.e., Beazly : *Dawn of Modern Geography*, Vol. II, p. 7.

3. Barthold : *Mussalman Culture*, pp. 142-43.

IDRISI'S WORLD MAP

(C 1154. A.D.)



1 MOUNTAIN OF THE MOON
AND SOURCES OF THE NILE
2 AL - ZANJ
3 SUFĀLAH
4 SINDH
5 SARANDĪB (CEYLON)
6 QUMĀR (MADAGASCAR)
7 AL - ḤABSH (ABYSSINIA)
8 AL - NŪBA (NUBIA)
9 BILĀD AL - LAMLAM
10 BILĀD AL MUFRADAH
11 AL - HIND (INDIA)
12 AL - ṢĪN (CHINA)
13 AL - TIBAT (TIBET)
14 KHURĀSĀN
15 KHAWĀRIZM

16 AZKUSH
17 TURK (TURKS)
18 MĀJŪJ (MAGOG)
19 YĀJŪJ (GOG)
20 BULGHĀR
21 JANŪBIA (PROBABLY SWEDEN)
22 BALTIC SEA
23 GERMANIA (GERMANY)
24 DENMARK
25 FELUWIAH (NORWAY)
26 THŪLĪ (BRITAIN)
27 AFRANSIAH (FRANCE)
28 ITALY
29 QARZQAH (CORSICA)
30 SARDĀNIA

MUHAMMAD ASHRAF,
PUBLISHER, LAHORE. (INDIA)

Though much of the originality of earlier writers is missing yet to say that the geographical literature ceased to contain any valuable information and assumed the shape of cheap imitations, is not only to misunderstand but to ignore its content. It has already been shown (*vide* Chap. IV) how the work at Maraghâ and Samarqand was of high quality in the field of astronomical and mathematical geography. European travellers still very largely depended upon Muslim sources for their information. Marco Polo has used many geographical names in their Persian forms and speaks of the information he derived from Muslim navigation charts in Ceylon. Persian astronomical influence is traceable in China[1] and lasted up to the seventeeth century. Rashîd-ud-dîn's historico-geographical works stand out unique among contemporary contributions of both the East and West. His work provides a mine of information about Chinese borders, Mongolia and Siberia which was not forthcoming till his times Much later than that, Hâjî Khalîfah produced his geographical treatise 'Kashf al-Zanûn' which can be considered the first attempt to compare the data of European geographical literature with that of the Muslims. Post-Columbus Europe failed to show the existence of any such attempt. Thus Aulia Chelibi's description of travels is considered by a great European scholar[2] in its completeness and many-sidedness of information far above the writings left by the best Arab geographers. In the domain of nautical science and information about the seas, the works of Shihâb al-Dîn and Al-Mahrî can stand comparison with the best of the

1. Barthold : *Mussalman Culture*, p. 115.
2. *Ibid*, p. 140.

specimens of the days of Prince Henry the Navigator and it took the European seamen several generations to acquaint themselves with the Indian Ocean to the same degree.

Ever since the birth of modern geography increasing attention has been paid to the study of the history of geographical thought and the evolution of this important social science. But it is usual with many a Western writer to speak of the Muslim contribution as brilliant but a kind of 'detached' development influencing renaissance geography in Europe only indirectly.[1] It is also not unusual to find some modern geographers[2] going to the extent of completely ignoring the value of Muslim achievement and denying its bearing on European geographical thought by saying that the rise of Muslim culture between 700-1400 A.D. though marked by the production of gazetteers, accounts of travel and speculation concerning the function of environment in human affairs had little or no effect on Western cartography and other aspects of geographical thinking. Certainly the above view is inspired either by ignorance or prejudice. But a large majority though recognising a period of 'brilliance' (so-called Classical Age!) believe in the rapid 'fall' or 'decline' of Muslim geography no sooner scholasticism raised its heads in the West. The remarks of Raymond Beazley[3] typify this attitude, "The outlook of Europe had greatly extended, all absorbing ambitions of the Saracens have been thwarted—in parti-

1. Baker : *History of Geographical Discovery and Exploration*, p. 70. Also Hitti : *History of the Arabs*, p 570.

2. H. Davies : *Earth and Man*, p. 7.

3. R. Beazley : *Dawn of Modern Geography*, Vol. II, p. 7.

cular its geographical outlook, its knowledge of the world, both practical and scientific has been widened, and deepened, while that of its great rival is already giving signs of an autumn, which however splendid is an autumn still. We must not be deceived by exceptions .... The slowly dying flame blazes up once more in a brilliant farewell with the work of Ibn Baṭṭuṭa and Abul Fida; but after this there is little but cold and darkness." As a matter of fact the continuity of higher Muslim culture, the production of geographical works and the limitations of renaissance geography in Europe till the very advent of the Age of Discovery[1] tell a different story of development. The too often repeated thesis that geographical thought of the renaissance mainly grew out of the 'back to Greek works' cry, the broader implications, of the 'Age of Crusades' as distinguished from the contact with the world of Islam during the Crusades and the fall of Constantinople giving impetus to learning, should not be unduly exaggerated. The tendency is dangerous, because it leads to a distorted view of the history of world culture and falls in line with the crotchety thinking like Spengler, encouraging an unscientific belief in the absolute isolation of cultures; bestowing an air of uniqueness to all renaissance thought. Therefore, it is desirable for students of the history of geographical thought to properly evaluate the merits of Muslim geography in the evolution of geography as such and no longer leave the subject merely as a special interest of orientalists.

The survey which has been undertaken in the above pages would convince us of the fact that cultural

1. Kimble: *Geography in the Middle Ages*, p. 208.

growth has not come about in watertight compartments. It is a story of wide contacts, actions and reactions. And if we look at the history of the Middle Ages we find that there stretches before us a panorama of fruitful contact between Europe and the world of Islam, through not only a bitter antagonism and warfare which lasted for several centuries; but also as a result of prolonged commercial intercourse covering all corners of the Mediterranean lands in Europe, Asia and Africa, which facilitated the passage of commodities as well as ideas and knowledge and information about the then known world. And the far-reaching effects of the intermingling caused by the long wars of the Crusades are increasingly appreciated in spite of the argument of the 'Age of Crusades' which is said to have commenced earlier. Thus it cannot be denied that "the renaissance of Western Europe in the Crusading Age was fully as much an intellectual, as a material and political movement. Science was at last touched and changed by the new life as completely as the arts of war, travel, trade and missionary enterprise. And among other branches of science none made greater progress than geography.[1]

No less important for transmitting the intellectual attainments of Muslims was a fillip to intellectual pursuits in Europe which inspired a vast translation activity to bring within the reach of the Christian world not only the classical works but also the wisdom attained by the Muslim workers in the field of philosophy and science (including among others astronomy, mathematics and geography). This transference of Muslim knowledge into Hebrew and Latin and then

1. R. Beazley: *Dawn of Modern Geography*, Vol. II, p. 8.

into many national languages of Europe not only influenced the Scholastic Age but through it permeated into the making of the renaissance thought. Let us look closer into this aspect of the cultural history of the Middle Ages, because it has such an important bearing upon the influence of Muslim geographical thought on renaissance geography.

Around and across the Mediterranean there developed many centres where from the tenth to the thirteenth century flourished an extensive translation activity. Egypt, the Syrian coastal towns, Sicily, South Italy and Spain were the seats of this study and acceptance of Muslim achievements worthy of translation into Latin. The Libraries of Toledo, Cordova, Seville, Palermo, Alexandria and Antioch largely consisted of works in Arabic. There were more commentaries than translations of Greek originals and a vast number of Muslim works on astronomico-mathematical-geographical subjects. The influx of eager students from all over Christendom to Spain was remarkable indeed, it seems as if, all roads led to this point of contact between the world of Islam and the newly-aroused intellectual fervour of Europe. The school of the Archbishop of Toledo under the supervision of Archdeacon Dominico Gondislavi and with the co-operation of the Hebrew Johannes ben David in 20 years rendered into Latin a large number of Arab works on science and philosophy. The first translation of the 'Almagest' from Arabic into Latin was made by Gerard of Cremona in 1175 A.D. Likewise the same scholar after crossing over from Italy to Spain, translated among other things

Banu Musâ's works, Al-Khwârizmî, Al-Farghânî, Al-Nairîzî, Thâbit b. Qurra, Al-Bîrûnî's commentary on Khwârizmî, the tables of Jâbir b. Aflâh and Zarqalî[1]. Other translators[2] were, the Italian Plato of Tivoli, Friedrich II, Michael Scotus, Robert of Chester and Hermanus Allemanus, all belonging to the thirteenth century. Many northern cities of Spain, *i.e.*, Taragona Leon, Segovia, Pamplona, etc. saw the settling down of these savants[3]. In fact, Spanish Arabic learning permeated all Western Europe and the intellectual avenue leading from the portals of Toledo through the Pyrenees wound its way through Provence and the Alpine passes into Lorraine, Germany and Central Europe as well as across the Channel into England[4] Adelard of Bath in his travels in Asia, Egypt and Spain studied the mathematical and astronomical works of the Arabs, with a view to translating them into Latin on his return to England.

Earlier, in the eleventh century the Carthaginian Constantino Africano travelled for 30 years in North Africa, and the Orient, with a view to teaching Arabian medical science at Salerno (S. Italy) and to translating Arabic works into Latin when a monk at Monte Cassino. Constantino brought to this Benedictine school his learning derived at Arab schools in Iraq and Egypt. Later the existence of Muslim culture in Sicily and the patronage of learning by the Norman

1. Sarton : *Introduction to the History of Science*, Vol. II, p. 321.
2. Joseph Hell : *Arab Civilization*, p. 111.
3. Kimble : *Geography in the Middle Ages*, p. 75.
4. Hitti : *History of the Arabs*, p. 589. (Also see Bernard Louis : *England and Arabic Learning*, pp. 2-6. (Six Talks, broadcast from B.B.C., London) Pub. Govt. of India, New Delhi, 1944.

Kings of the island provided a sort of international plank for the promotion of knowledge. All three tongues, Greek, Latin and Arabic existed side by side and we have a story of friendly relations between the Christians and the Muslims throughout the twelfth century resulting in a wide dissemination of geographical and other knowledge about the lands of Islam. No wonder then, that Idrisi's work is an example of this cosmopolitan co-operation. Thus the unfolding of many parts of Africa, south of the Sahara to Christian Europe through Muslim sources, led the Popes to despatch friars that had learnt Arabic into that direction.[1]

Thus we get a picture of the contact of the Islamic and Western culture in peaceful relations rather than merely in stresses of warfare. Contrary to popular belief, there was the transmission of Muslim knowledge including geographical ideas and conceptions on such a large scale, and it can easily be imagined how considerable and far-reaching its effect must have been on scholasticism and renaissance geography.

It led to a quickening of the scientific impulse without parallel in the earlier history of Europe. That is why we find Adelard of Bath declaring in his original work (Natural Questions) to an imaginary questioner steeped in European ignorance, that he had learnt from the Arabian masters based upon reasoning, while his co-religionists were captivated by authority and followed their halter, and thus he compared them to 'brute beasts'.

Now it remains to show briefly, the many-sided influence of Muslim geography in the European

1. Kimble : *Geography in the Middle Ages*, p. 101 (quoting from *Balanquerna*, p. 356*et seq.*)

geographical writings from the thirteenth century to the commencement of the Age of Discovery. We can dismiss the pilgrim's accounts of Christendom (*i.e.*, John of Wurzburg. Joannes Phocas, Richard Coer de Lion, Sigurd of Norway, etc.) all of the twelfth century, with scant attention because they only reveal the authority ridden and 'other-worldly' mind of Christian Europe. They are more concerned about churches, scenes of Jesus' activity and tales of saints rather than descriptions of the world. The outstanding, more 'geographical' works, which followed, included the 'Tractatus de Sphaera' of Joannes Sacrobesco (John of Hollywood), the biblical ridden compendium of knowledge 'Speculum' of the Dominican Friar Vincent of Beauvais (c. 1250), writings of Friar Albert the Great, Roger Bacon's 'Opus Majus', 'Image du Monde', (attributed to a certain Gossuin of Metz) and the 'Travels' of the Englishman Sir John Mandeville. Some of these works show originality here and there and a tendency to break the shackles of patristic authority. Traces of Muslim influences in these and other European writings can be classed under the following heads (*i*) Astronomico-mathematical field of geography, (*ii*) Cartography and the making of charts; (*iii*) Other geographical fields—descriptive and analytical.

ASTRONOMICO-MATHEMATICAL GEOGRAPHY

It is beyond the scope of the present work to provide a detailed study of the relationship between Muslim geography and the European writings on the subject, till the advent of the Age of Discovery. But

there is ample evidence to show that the field in which Muslim geographical contribution exerted a most extensive and far-reaching influence was mathematical. The later brilliant epochs of Peurbach, Regiomontonus, of Copernicus, cannot be recalled without reminding one of the fundamental preparatory labour of the Arab mathematician-geographers. They had a flair for interlacing their theories with practical examples. The result was that geodesy (the science of earth measurement)—the calculation of height of mountains, of the width of valleys or the distance between two objects situated on a plane surface, reached a high state of perfection and had a practical and utilitarian aspect in designing aqueducts, in applying the principles of mechanics to the making of weapons of warfare and laboratory instruments.

Among the numerous writings of Adelard of Bath those of direct geographical and astronomical interest were (*i*) Ezrich Elkauresmi (Zij al-Khwârizmî) as revised by Maslama at Cordova; (*ii*) Questiones Naturales, which was meant to explain what Adelard had learnt from the Arab masters (this work has many manuscripts); (*iii*) De Operatione Astrolabii (the working of the astrolabe) which was perhaps the earliest treatise on the astrolabe, written by an Englishman. Here the author quotes from his 'Ezrich'. The terms of dedication, it is pointed out by Darby,[1] mark the coming of Arabic learning to the West and sets forth a commendable sense of the proper evaluation of respective cultural contributions which many modern scientists, unfortunately prefer to forget. It is clear

1. Darby: A Note on an Early Treatise on the Astrolabe, *Geographical Journal*, February 1935, p. 180.

that Adelard's familiarity with the science of the Arabs was far from being a superficial matter and his treatise on the astrolabe deserves to be more widely known. Further, in connection with the early treatises dealing with the astrolabe, the work of Bubnov and Thorndike[1] and Haskins has revealed the part played by these treatises in the introduction of Arabic science to the West. It is said[2] that there is extant a Latin treatise on the astrolabe in 21 chapters which may have been a translation from Arabic and is regarded among the doubtful works of Gerberts of Aurillac (950-1003) who later became Pope Silvester II.

Sacrobesco, the writer of 'Tractatus de Sphaera', was an Englishman and a student of Robert Lincoln and about 1250 A.D. he had made use of Macrobius. He had greatly learnt from Arabic authorities and became remarkably popular during the later years of the Middle Ages, so much so that he remained an authority up to late sixteenth century. From his 'Sphaera' the early Portuguese shipmen and even Vasco Da Gama got the value of a degree which they put as $17\frac{1}{2}$ sea-leagues. But it is beyond doubt that Sacrobesco had read Al-Farghânî and for the extent of the 7 'climata' of the earthball he made use of his measures. In a Latin work by an unnamed author (MSS in British Museum) the ideas of the size of the earth by all famous writers including Theodosius, Macrobius, Aristotle, Ptolemy, Al-Farghânî and Al-Baṭṭânî were taken into consideration. And the writer has discussed the merits of the measure-

1. Lynn Thorndike and Haskins: *History of Magic and Experimental Science.*

2. Darby: A Note on an Early Treatise on the Astrolabe, *Geographical Journal*, February 1935, p. 179.

ments of Ptolemy and Alfragan (Al-Farghânî)[1]. An outstanding figure in the Age of Scholasticism and the birth of scientific thought in Europe, is that of Roger Bacon the writer of 'Opus Majus.' He has often been rated higher as a man of science than he really was. Because he was far from being a rebel against ecclesiastical authority and never drifted apart from the truth of the Christian revelation. However, among the Arab authorities mentioned by him in connection with astronomy, mathematics and geography, whom he had consulted, we find such names as Abû Ma'shar, Al-Farghânî, Ibn Sînâ, Al-Baṭṭânî, Thâbit b. Qurra and Zarqalî. He noted Abû Ma'shar's idea that "vapours are not higher than two miles and a tenth and a third of a mile. Older meteorologists had estimated the extent of the clouds from 40 to 50 miles".[2] Speaking of the same writer's 'Book of Conjunctions' he says that through it a knowledge of astronomy had come into the hands of Latins, who had none of these sciences.[3] He named Abû Ma'shar (Albumasar) in numerous references in connection with mathematics and moral philosophy. Bacon mentioned Al-Farghânî in considering the radius of the earth and its circumference and the size of heavenly bodies, and after him gives the circumference as 20,428 miles.[4] In numerous matters he accepts the classical view after reference to attestation by Muslim writers. For example, discussing at length the extent of the earth covered by the ocean between Spain and the

1. Taylor: Some notes on Early Ideas of the Form and Size of the Earth, *Geographical Journal*, 1935, Vol., LXXXV, p. 67-68.

2. R. Bacon: *Opus Majus*, Vol. I, p. 252.
3. *Ibid.*, Vol. I, p. 405.
4. *Ibid.*, p. 249.

further end of India and China, he says[1] "All these things I have written, following principally Ptolemy and Alfraganus (Al-Farghânî) and the table of latitudes and longitudes of those states. For in the latitudes of the climates and of the spaces before and after the climates, I have followed the view of Ptolemy in the 'Almagest.' But Alfraganus has been my chief authority in what I have written in regard to the extent in miles of the climates and spaces . . . . I sometimes make a change and an addition as the need arises for greater certainty . . . ." He also copies the idea of Arym (Arrin) from the Arabs. In spite of this our scientist was ignorant of Islam and all aspects of the cultural life of the Mussalmans. Blind with prejudice he wrote all kinds of nonsense about the Prophet of Islam. Obviously a great hatred of Muslims prevented him from taking into account writings dealing with manners, customs, social habits and other facts of their cultural environment. Lastly, Dante's writings here and there contain a large amount of geographical information and reveal the kind of earth knowledge held by the intelligentsia of Italy in the early fourteenth century (1265-1321). Al-Farghânî's influence is noticeable, for example the size of the earth is given as 20,400 miles.

Cartography (Maps, Charts and Navigation)

It is said that the maps of a period throw much light upon its history and as the mentality and spirituality of an age are reflected in its buildings and works of art; they may also be enshrined in its maps.[2] What do

1. Roger Baton : *Opus Majus*, Vol. I. p. 318.
2. Jervis; *The World in Maps*, p. 68.

we find if we apply this generalisation to the development of Muslim cartography? Unfortunately few originals or copies of the work of Arab map-makers have been handed down to us. There is no trace of the early achievements of Khwârizmî (Mâmûn's map of the world) Balkhî, Iṣṭakhrî, Ibn Hawqal, Maqdisî and the writer of 'Hudûd al-'Âlam.' Even the extant Idrîsî map of the world is a fifteenth century copy. Thus it is difficult to judge fully of their merit. Though some scholars[1] by their painstaking work, make it possible to arrive at a fair estimate of Muslim cartography. Comparing with the sum total of their whole geographical knowledge, Arab cartography seems to be backward[2] because much more is found in texts than in maps. But there is no denying the fact that the scientific work of the Arabs in the domain of cartography, carried on to some extent pre-Christian and Ptolemaic traditions and moulded them into a scientific form of their own. It must have been easier for the Arab sailors to solve the problems of fixing direction and representing distance, when one finds them armed with the compass, astrolabe and quadrant. The problem of map projection was not easy and in spite of the attention devoted by great minds like Al-Bîrûnî, it remained unsolved till the times of Mercator (1538).

But what does one find in Europe? The Western ecclesiastical schools of mediæval geography, finding discrepancies between the Holy Writ and scientific observations did not hesitate in accepting the former

1. Prince Yousouf Kamal: *Monumenta Cartographica* and Konard Miller: *Mapae Arabicae*.

2. *Vide* Chap. III.

unconditionally and were ever prepared to deny the validity of science. The taste of the age was for the marvellous and the fantastic and the depiction of the meaningless yet traditional and legendary jargon coloured, with a religious bias was the main feature of map drawing. Such is the background of the so-called *mappaemundi*—maps to show the knowledge of the earth before a synthesis of the portolani charts and the work under Henry the Navigator took place. To this class belong such outstanding examples as the 'Psalter' map (c. 1200) the Hereford map (c. 1280) Marino Sanuto's world map (1321) the Borgian world map (1450) Este world map (c. 1450) Fra Maura's Africa (1459) and the diagrams of *Image du Monde* (1480), etc. These maps were utterly removed from reality and show the terrific weight of tradition, classical as well as ecclesiastical and patristic. The Ptolemaic world map in the meantime, remained in total eclipse, save for the period when it attracted the attention of the Arabs.[1] But in spite of such overpowering theological drag the map-makers of Europe could not be entirely oblivious of the rapid advances in knowledge made by their neighbours. Distinct trace of acquaintance with Arabian geography is to be found in the world map of Marino Sanuto the Elder, constructed between 1300 and 1321 A.D. and the main purpose of which was to stimulate a new crusade![2]

Throughout the middle ages, it seems, there existed a close relation between navigation and cartography. It is generally supposed that throughout this

1. Kimble: *Geography in the Middle Ages*, p. 188.
2. Yule and Cordier: *The Book of Ser Marco Polo*, Vol. I., p. 133.

period the open ocean inspired a great fear in mariners and sailors, perhaps largely due to the lack of proper instruments to fix their positions. That ships were small, no bigger than barges and therefore unseaworthy, is taken for granted. It was only after the invention of the compass that bigger ships came into being. Such suppositions are not borne out by a study of Arab navigation.[1] For centuries before Columbus crossed the Atlantic to search for Paradise to the south-west and incidentally India too; the Indian Ocean stretching all the way from the Arabian and African coasts to South-east Asia waters had become 'beaten track' of Arab sailors. On these waters apart from small coastal vessels, also sailed huge craft carrying no less than a thousand persons. Towards the close of the tenth century A.D. Mas'ūdī speaks of the prototypes of modern shipping companies with large ships. The mysteries of the Atlantic were certainly not very seriously probed into by Muslims beyond a few attempts which brought them the knowledge of the Azores and the Canaries, etc. (*vide* Ibn Sa'īd and Idrīsī). There were reasons for that. Their ideas of the sphericity of the earth (minus the knowledge of the existence of the Americas) brought to their mind the reaching of South-east Asia and China by a westward sailing. But the question would have been, was it worth the trouble to face the risk of sailing into the unknown waters of Baḥr Muḥīṭ or Zulmât (Atlantic Ocean) when they could contact these lands easily *via* the Indian Ocean? The Mussalman world of the Maghrib (Morocco and Algeria, etc.) and Andalus (Iberian

1. See Carrade Vaux: *Les Penseur de l'Islam*, Chap. I, Vol. I. Also *vide* Buzurg ibn Shahriyar and Mas'ūdi.

Peninsula) ought to have been more interested in the Atlantic sailings. But their case was different from the problem facing the European sailors. To them contact with India and a share in the Far Eastern and Chinese trade was assured through the Muslim 'Sea-lanes' of the Mediterranean and Indian Ocean and the Overland routes to the confines of China and beyond. The East lived in the imagination of the fifteenth century European sailors and navigators and provided an incentive to 'sail west' aided by Ptolemy's underestimates of the earth's circumference and the search for Paradise.

The main cartographical achievement of the Middle Ages, however, was not the ability of the makers of *mappaemundi* but the creation of portolani or sailing charts. Their origin is mysterious. But their appearance was attendant on the need that was felt in widely-separated areas as a result of extensive maritime activity. In the Arabic world, their origin is certainly connected with extensive sailings over the open waters of the Indian Ocean and the Far East as well as the appearance of many professional pilots,[1] the so-called 'Lions of the Sea' (*i.e.* Muḥammad b. S̲h̲âd̲h̲ân Sahl b. Abân and Lait̲h̲ b. Kahlân, etc.) who are mentioned by Aḥmad ibn Mâjid[2] the great navigator of the late fifteenth century A.D. Even Maqdisî writing as early as the late tenth century A.D. while speaking of his extensive sailings over most of the known waters of the Indian Ocean, wrote, "I was thus thrown in the company of men shipmasters, pilots, mathematicians (A lacuna in the edited text; the word reads like رياضين mathemati-

1. G. Fernand: Introduction *L'astronomie Natique Arabe*, p. 225.
2. *Vide* Chap. III,

cians) agents and merchants who had spent a life-time on these waters, possessed the clearest and fullest knowledge of this sea, its anchorages, its winds and its lands. I plied them with questions concerning its position, physical peculiarities and its limits. I have also seen in their possession charts and sailing directorie which they constantly study and follow with implicit confidence. From these sources, therefore, I have drawn, with careful discrimination and close attention, a sufficient account embodying the best information I could acquire, which I afterwards compared with the charts already spoken of[1] . . . "

The continued use of such charts is further confirmed by the observation of Marco Polo[2] who confessed that he derived his knowledge of the Ceylonese Coast and waters near-about from the charts of mariners of these seas. Ramon Lull also mentioned the carrying of the compass and the charts. Though there may not have been a multiple production of such charts and the element of secrecy may have been there but their wide use is established beyond doubt. No traces of these specimen have so far been discovered, but it would not be surprising if some time in the future some copies may see the light of day.[3] The Arab sailors continued to use their charts, and instruments and their high value

1. Maqdisi: *Ahsan al-Taqāsīm*, p. 14.
2. Yule and Cordier: *The Book of Ser Marco Polo, op. cit*, Vol. II, pp. 312-13.
3. I am told on the authority of my colleague, Mr. Sultanul 'Alam, Lecturer in Arabic at the Calcutta University, that in his home district Chittagong, among some families of the Arakan Coast is reported the possession of very old sailing charts which are regarded as a precious ancestoral heritage and are never shown to strangers. The war has left a deep scar along the Arakan Coast and life has been greatly disrupted. No one knows the value of the above-mentioned charts but the knowledge of some specimen may lead to a discovery of first-rate importance.

even when it was long past the Age of Discovery was realised by Europeans. Sir Thomas Roe speaking in 1615 said that in Madagascar he met Mu'allim Ibrâhim, who corrected his card.[1] An European historian correctly remarks,[2] "The Arabs at that time (15th century), knew the use of the compass, and had sea-charts and maps wherein the situation of the countries were laid down with great accuracy; nor were they without quadrants, with which they took the altitude of the sun and the latitude of places. In short, so great was their skill in these arts, that they seemed to be very little inferior to the Portuguese pilots, in knowledge of maritime affairs."

The European portolani are first mentioned in connection with a crusade[3] in 1270. And it is accepted by all that they had a long process of evolution, Carte Pisan (c. 1300) being the earliest extant example. Their making first continued in the flourishing cities of Northern Italy and then along the Catalan Coast, culminating in the best example, *i.e.*, the Catalan Atlas of 1375. But it is thought that even the earliest Carte Pisan, which is a crude attempt, appears to be a copy of an older chart or series of charts.[4] It is said that the Catalan Map of 1375 represents the most complete mediæval embodiment of Polo's Geography and it is for the first time, apart from the correct position of China, that the Indian Peninsula is shown with some approximation. But according to Peschel,[5] Al-Birûni had

1. G. Fernand: Introduction, *L'astronomie Natique Arabe*, p. 236.
2. *Ibid.*, quoting from J. Gibbs: *History of the Portuguese during the Reign of Emmanuel*, Vol. I., p. 53.
3. Dickinson and Howarth: *The Making of Geography*, p. 62.
4. Jervis: *The World in Maps*, p. 71.
5. Yule and Cordier: *The Book of Ser Marco Polo*, Vol. I, p. 134.

already done it. Though it is true that a great many things in the map show Polo's information but there are many place names and areas, it is pointed out, which the Venetian does not mention *i.e.*, Delli (Delhi) Deogil (Deogir) Cambetum (Kambayat-Cambay) Baroche (Baruch) Neruala (Anhilwara) and portions of China, Turkistan and Siberia. Obviously the source for these was Muslim geography. It has so far not been possible to establish a clear relationship between the European portolani and the earlier Arabian attempts (none of which now seem to have survived). But enough has been said to show that the Western models may not have been an entirely new thing (as is commonly supposed) without a degree of influence from the earlier and widespread Muslim specimens as well as their geographical writings.

The next stage in mediæval European map-making is marked by the synthesis between the portolani charts and the practical navigational experience acquired under the guidance of Prince Henry the Navigator. Henry's earliest struggles against the Muslims in North Africa, near-about Ceuta, when he was only 21 years of age (1415 A.D.) had excited his interest in the extensive knowledge of the world possessed by his enemies. He gleaned much valuable information from the Muslims at Ceuta, concerning such regions as inland Africa and of the trade carried on with the interior possibly, at least as far as, the Guinea Coast.[1] On return home and becoming the ruler of his kingdom he became a patron of learning, and geography and navigation interested him

1. Keane : *The Evolution of Geography*, p. 84.

most. He provided instruction in cartography and astronomy, including the use of appropriate instruments and is said to have chosen his teachers with a commendable disregard of political sentiment (and a religious bigot he was) as some of his mathematicians were Arabs.[1] The result of this many-sided synthesis after the times of Henry is discovered in the maps of the fifteenth century which followed. The problem of reconciling traditional hotch-potch of world knowledge with results of practical observation and wide range of information from Muslim sources; became acute and that sort of confusion is particularly witnessed in (otherwise one of the outstanding efforts of these times) Fra Maura's map (1459) which shows less accuracy than the Catalan map. For parts of Africa, *i.e.*, Abyssinia, he knits Polo's accounts into Arab conceptions and makes them fit together. The other three examples, the Este, the Walsperger and the Genoese maps, all of approximately the same date (c. 1450) show an unmistakably strong Arab influence. Commenting upon the Este map a modern scholar[2] says, "of these influences the Arab is strong, while it is improbable that the classical influence is direct. Thus, the map owes nothing to Ptolemy and it is less likely that its author should have taken his idea of a southern continent direct from Crates, the originator of the concept, than that he should have taken it from Arab or Christian cosmographers, such as Abu'l Fidâ or Isidore who revived it. The influence of the mediæval Christian tradition is betrayed in such things as the legend relating to Prester

1. Dickinson and Howarth : *The Making of Geography*, p. 72.
2. Kimble : *Geography in the Middle Ages*, p. 197.

John and the portrayal of the Terrestrial Paradise. There can be no mistaking the Arab influence. We have only to compare the delineation of the southern half of Africa on the map with the description given by the eleventh century writer, Al-Birûnî, of the shores of the Southern Ocean to be convinced of the kinship".[1] In Fra Maura's map can be recognised such Arabic names as Abasia (Ḥabsh-Ḥabshah) and Saylân (Ceylon) and in Martin Behain's globe (1442) we also read Moabar (Ma'bar Coromandel Coast).

The spirit of rejection of material from Arabic or even Christian travel literature, including that of Marco Polo, as against Church views and out-of-date Ptolemaic knowledge; was so great that even after the commencement of the Age of Discovery, Europeans went on rejecting the proven facts of earlier information. No wonder then that often specific mention of information derived from Arabic sources is not made. Such information was certainly available, though it was not displayed in its entirety on maps and incorporated in texts by proper acknowledgment. But it helped to increase the confusion in mediæval European geography between the real and unreal which lasted till the sixteenth century and produced "a most extraordinary hotch-potch conveying no approximation to any consistent representation of facts."[2] We find evidence of this in the maps of Mercator (1587), Magini (1597 etc.). Even in Sanson's map (1659) though the data of

1. For 'the countries beyond the Equator with winter instead of our summers' See Prof. Ahmad Zaki Validi's *Al-Birūni's Wettbild* as well as the *Pharmacology of Al-Birūni*, Brusa, MS. as suggested by the Prof. Also Yāqūt's *Mu'jam-al-Udaba*, Vol. VI, p. 310.

2. Yule and Cordier : *The Book of Ser Marco Polo*, Vol. I, p. 136.

Polo and mediæval travellers is more cautiously handled, yet a new element of confusion is introduced in the form of numerous features derived from Idrisi (*vide* Tr. published in Rome, 1526).

Descriptive and Regional Geography

It is generally supposed that it was only in the astronomico-mathematical and cartographic fields that late mediæval and renaissance geography in Europe, was partly influenced by Muslim geography and what can be called, literary Islamic geography left no direct impression on European mediæval thought, as the works of these geographers found no translators into Latin.[1] But in these pages we have briefly surveyed the many-sided contact between the lands of Islam and Christian Europe; which is manifested in trading and commercial activity, transmission of social habits and cultural attitudes and a widespread intellectual activity. Therefore the enlightened minds in Europe could not be wholly unaware of Muslim achievements in the fields of descriptive and analytical geography. By the time the Crusades came, the Arab enterprise had extended to commercial relations much beyond the limits of Ptolemy's world. By the contact of the East and West during and after the Crusades, the whole of Europe profited. It was in the general raising of the standard of life following the Crusades that men's mental horizon became enlarged and the riches of the East, its gold, silks, jewels, spices and works of art became familiar throughout Christendom. The conception of a 'world summit' known as Arin, derived from

1. Hitti : *History of the Arabs*, p. 387.

the Hindu sources, was an important point in all Arabic system. It found its way from Arabic sources into the 'Opus Majus' of Roger Bacon and later into the Image du Monde of Cardinal Pierre d'Ailly, from whence Columbus derived his notion of another world summit 'over against the mouth of the Orinoco', as he wrote to his patroness, Queen Isabella.[1]

With the news of the spectacular rise of the Tartars from the grasslands of Central Asia, the Popes were obsessed with the idea of converting these heathen nomads and to harness their zeal to crush Islam. Thus were sent priestly ambassadors, the Friar John de Plano Carpini in 1245 and the Friar William de Rubruquis (July 1253). Then came Marco Polo's journeys (1271) and the Friar Odoric went East in 1318. Of these, the earlier friars were more interested in their religious mission, rather than geographical information, though some of their observations found place in European writings. Odoric, practically, added nothing to geographical knowledge. Polo contributed a great deal of new facts to the knowledge of the earth's surface possessed by mediæval Europe, but no such results occurred speedily, nor was its beneficial effect of long duration. Because "the essential causes included the traditional character of the European mind suffused with religious obscuranticism which clogged geography as well as other branches of science and human knowledge. There was an entire absence of the scientific principle. Two things exercised a tremendous weight on medæival European mind, the pseudo-geographical conceptions of

1. Keane: *Evolution of Geography*, p. 48.

Christian Fathers and the numerous out-of-date ideas of classical geographers, *i.e.*, Strabo, Ptolemy, etc. Anything which cut across these ideas though based upon actual observation was not easily accepted, nay, at times, vehemently opposed and ridiculed."[1] Thus is explained the apparent non-acceptance of Arab knowledge of the world, but in spite of this reluctance is found a consistent reference to those sources in the geographical and semi-geographical works of European origin.

The Dominican Friar Vincent of Beauvais (c. 1250) the writer of the biblical ridden compendium of knowledge, the 'Speculum', when speaking of the Nile valley cites Ibn Sinā among his authorities. In the writings of Friar Albert the Great, who often shows variance from the orthodox view of the world, are found traces of knowledge about the heart of Africa and the lands beyond the torrid zone, acquired from many Arabic sources. Next come the imaginary travels of the Englishman, Sir John Mandeville (c. 1356). These accounts are regarded as purely fictitious, filled with legends and fables, gleaned from other writers or from mere hearsay. There is found a revival of all old myths from Solinus, Pliny and Oderic and they have been cleverly intermixed with knowledge derived from the Arabic sources. The book gained immense popularity during the fourteenth and fifteenth centuries. It gives the European layman's idea of the world. The circumference of the earth is given as 20,425 miles after the Arab sources.[2] The writer's assertion of personal travel to lands beyond

1. Yule and Cordier: *The Book of Ser Marco Polo*, Vol. I, p. 130.

2. Compare with Farghāni's 20,428 miles given by Roger Bacon: *Opus Majus*, Vol. I, p. 249.

the equator, observances of the Antarctic Star instead of the Arctic and the suggestion that there must be more habitable lands to the South and the East than was commonly supposed, throws an important light upon the contrast that existed between the accepted facts about the world in that direction, in the West, and the matter of more common knowledge in the lands of Islam. The above instance may very well point to the influence of Muslim knowledge of the geography of the world (*vide* Mas'ûdî, Al-Bîrûnî, Idrîsî and many others). Such accounts were certainly of consequence in their impact upon the minds steeped in tradition and provided a stimulus to consider facts about the earth based upon observation. Cardinal Pierre d'Ailly's Tractatus Imagine Mundi, written 140 years after Roger Bacon, is on the other hand oblivious of contemporary exploration and travel and as has been well said, "The whole work with the exception of a few Arabic citations, mainly from Latin translations of the works of Ibn Sînâ and Ibn Rushd might have been composed a thousand years previously.[1] Thus continues the zigzag course of early renaissance geography.

Knowledge of many parts of Africa *i.e.*, the Shara, Sudan (Ghanâ, parts of Guinea Coast, Senegal and Nigar peoples), was mainly derived from Muslim sources. It was based upon a highly-deveolped trading and commercial activity with theselands and the Muslims of North Africa knew of their riches, and through them the knowledge was passed on to the Southern Mediterranean lands of Europe. Peoples of the West learnt from them of the

1. Kimble : *Geography in the Middle Ages*, p. 209.

great value of this trade and the mineral wealth of the West Coast of Africa. In the next period we find the great outburst of Portuguese maritime activity preceding the rounding of Cape of Good Hope. Among the reasons for this quest, apart from the religious zeal of joining hands with the mythical Prester John (a desire stimulated by the final defeat of the Crusades) and the desire to reach the Far Eastern Waters; was also the hope of immediate gain from the trade and gold of the Guinea Coast derived from the knowledge emanating from Muslim descriptions.

As has already been pointed out (*vide* Chap. II) Arab attainments in the domain of physiography were of a high standard as interesing light was thrown on the understanding of the processes of denudation, earthquakes, orogenics, tectonics and even continental drift. The writers of the treatises of the 'Ikhwân as-Ṣafa 'Ibn Sînâ' and 'Al-Bîrûnî' often took up these matters. Europe, it seems, did not remain entirely ignorant of these saner views. For instance,[1] in a translation of a possible work of Ibn Sinâ by a certain Alfred of Sareshel, views are put forth regarding the origin of mountains and valleys which would surprise many modern geographers. Rivers, their work in general, and the regime of the Nile floods were studied by many writers and reached Europe through the writings of Benjamin Tudela and Leo Africanus among others. Thus here and there and in multiple ways, Arab geographical ideas contiuned to reach Europe throughout the centuries when the West lived under

1. Kimble : *Geography in the Middle Ages*, p. 169, also. Geiki : *Founders of Geology*, p. 43.

the shadow of an intellectual paralysis which affected geography as any other scientific pursuit, and illuminated some minds in patches in the midst of the prevailing darkness.

In contrast to the supposedly sudden brilliance of the renaissance movement and the later glow which illuminated the modern developments of the West, from the Age of Discovery to the birth of the Palaeotechnic civilisation, the previous 700 hundred years (long centuries of growth and development of culture in Islamic lands) have often been treated by our Western savant as a stagnant period of insignificant achievements in human history. How did this notion become popular? Perhaps, the main reason, apart from a series of explanations is found in the prejudices and ignorance of Christian Europe which had too long been at loggerheads with the Muslim world and therefore was inclined to belittle its achievements. Thus the nineteenth century Westerner benefiting from the advances of the Palaeotechnic civilisation in his own times and the inherited ignorance of his predecessors, failed to appreciate the debt of the sailors of the Age of Discovery to Arab navigators and generations of Muslim seamen, of many aspects of his technic to the craftsman of Cordova, Granada, Cairo and Baghdâd, of waterworks and irrigation schemes to the Andalusian hydrolic engineers and the philosophic and scientific spirit, to a long line of thinkers and workers in these fields ; who have so enriched the Islamic heritage. The fact remains that for a long time during the Middle Ages, Europe was engulfed in backwardness. It was on the outskirts of

the wonderful civilisation of the lands of Islam and received from there inspiration and information concerning great material wealth and mental developments. This process continued from the eighth century onward. Today, there has grown up a tendency in politico-economic thinking of a superficial kind to call the lands of Islam inherently backward. As against this, will it not be interesting to remind ourselves of the views of Abu'l Qâsim ibn Sa'id the cultured Spanish Muslim judge of Toledo in the twelfth century regarding the capacity of the Europeans of his day ?[1] Speaking of their mental development, he said that they were of a cold temperament and never reached maturity ; they were of great strature and of a white complexion, but they lacked all sharpness of wit and penetration of intellect. Surely, our modern sociologists and human geographers would consider the above opinion highly exaggerated. But what about their own views of peoples of the East and the tropical lands ? That is why a lot of history will have to be rewritten.

Modern geography is of comparatively recent development. But far from being a sudden product of the nineteenth century its past stretches from the attainments of the classical geographers to the advanced and systematic handling of Muslim geographers. To a great extent their labours were assimilated by Scholasticism and in various ways the process continued to the period of the Renaissance and the Age of Discovery and onward to the birth of the Flemish and the Germanic schools.

1. Amram Sheinfeld : *You and Heredity*, pp. 349-50. Asol Inayatullah *Geographical Influences in Arabian Life and History*, pp 6-7.

APPENDIX I

AL-BÎRÛNÎ'S GEOGRAPHY OF INDIA[1]

Al-Bîrûnî is generally remembered as a great historian who wrote at a vital period in Indian history. But what interests a geographer most, is his extent of geographical information and amazing grasp of the fundamental influence of geographical factors in human affairs. In his great bcok ' Kitâbul Hind ' (Al-Bîrûnî's India) he gives ample proof of his understanding of geographical matters when he discusses here and there the various aspects of the geography of the country. He was no mere armchair intellectual. No sooner he arrived in India , he devoted himself to the study of the languages of the country, particularly Sanskrit and therefore his approach to numerous sociological problems had the sound background of the wisdom of native observations as well as personal study. His method, accordingly, was truly critical.

The following is an attempt to reconstruct the geographical picture of India from his multifarious observations scattered here and there in his great book on India.[2]

1. Reproduced with some alterations from the *Calcutta Geographical Review*, Vol. V, March, 1943, and Vol , V. December, 1943. From a paper by the present winter.

2. The text of *Al-Birūnī's India* translated by Edward Sachau (Kegan Paul). London, 1914, has been used and the extracts taken are from the same source. Help has also been taken from the excellent annotations at the end of the translation.

PHYSICAL SETTINGS—FRONTIERS, PHYSICAL BUILD, RIVERS, PLAINS, MOUNTAINS, ETC.

Speaking of the ocean south-east of the inhabitable world he says,[1] 'This sea is mostly called from some island in it or from the coast which borders it . . . . the sea which is bordered by the continent of India is therefore called the Indian Ocean.' The coast of India begins with Tîz, the capital of Makrân and extends in a south-eastern direction to Al-Daibal (Daibal)[2] and onwards to Kach and Somnath, Gulf of Cambay, western coast by Thana and then follows a great bay in which lies Singaldîb (the Island Sarandîp—Ceylon).[3] Along this southern coast are mentioned a number of places including Baroi (Baroda), Kanbâyat (Cambay), Bihrôj (Broach), Tânâ (Thana), Ramsher (Rameshvaram); Panjayavar (Tanjore), and Setubandha (Adam's Bridge), etc. The islands of the Indian Ocean mentioned are: 'The Zabaj called by the Hindus Suvarna-dvipa, *i.e.*, the gold islands. The western islands in this ocean are those of Zanj (Negroes) and those in the middle are the Islands Ramm and the Diva Islands (Maldives and Lacadives) to which also belong the Qumair Islands.'[4] In addition detailed references are made to Ceylon, which according to the author was known as the castle of the demons

1. Vol. I. p. 197.

2. Identified with the site of modern Karachi by Elliot (Vol. I. pp. 374-78). According to Cunningham & Crow Daibul may be located between Karachi and Thatta (see pp. 341-43) Ibn Khurdādhbih, Mas'udi and Ibn Baṭṭuṭa place it a few miles up the Indus. Indeed the repeated changes in the course of the Indus now make it difficult to be exact. Though it is mentioned even in Sasanian times and the Arabs captured it in 93 A. H. 712 A. D. (*Encyclopaeaia of Islam*, Vol. I, p. 896).

3. References in brackets are modern versions and have been added to facilitate identification.

4. Vol. I, p. 210.

and he goes on to relate the story of Rama and Sita's exile.

Along the northern frontiers of India many details of Kamshiir[1] are given and a description is provided of the tortuous course of the Indus. He speaks here of high mountains, peaks and of everlasting snow. 'In the west there lies the country of the Afghan tribes stretching up to the Sindh valley.[2] As to the chain of mountains traversing the heart of Asia, north and north-west of India, Al-Bîrûnî had an almost correct idea of its vastness and extent. 'As to the orographic configuration of the inhabitable world, imagine a range of towering mountains like the vertebræ of a spine stretching through the middle latitude of the earth and in longitude from east to west, passing through China, Tibet the country of Turks, Kâbul, Badakhshân, Torkhâristân, Bâmiyân, Al-Ghôr, Khurâsân, Media, Adharbaijân, the Roman Empire, the country of the Franks and of the Jalalika (Gallicians).[3] The mountains form the northern boundaries of India and they are the snowy Himavant (Himalayas) part of the drainage of which is directed towards Central Asia and part towards India. 'The northern and eastern mountains of India in reality form one and the same chain, extending towards the east and then turning towards the south, until they reach the great ocean (Indian Ocean) where parts of it penetrate into the sea at the place called the

1. Which will be dealt with later on.
2. Vol. I, p. 208.
3. *Ibid.*, p. 197

Dyke of Rama.[1] Of course, these mountains differ very much in cold and heat.'[2]

Quoting Bhuvanakosa,[3] Al-Bîrûnî says that the inhabitable world stretches from the Himavant (Himalayas) towards the south and is called Bhâratvarsha. North of the Himalayas lay the traditional Mount Meru, towering above the world and unapproachable in its majesty.

The Plain.—South of the Himalayas is mentioned the vast plain of India and in this connection the most amazing fact is that Al-Bîrûnî's discussion as to its possible origin is so scientific—'one of those plains in India, limited in the south by the above-mentioned Indian Ocean and on all three sides by the lofty mountains, the waters of which flow down to it. But if you have seen the soil of India with your own eyes and meditate on its nature—if you consider the rounded stones found in the earth, however, deeply you dig, stones that are large near the mountains and where the rivers have a violent current; stones that are of smaller size at greater distance from the mountains and where streams flow more slowly; stones that appear pulverised in the shape of sand where the streams begin to stagnate near their mouths and near the sea—if you consider all this you could scarcely help thinking that India had once been a sea which by degrees has been filled up by the alluvium of the streams.'[4]

1. Here apparently Al-Birūni confused the Arakan ranges with the Southern tip of peninsular India, close to the Adam's Bridge (a series of sandy islands).

2. Vol. I, p. 258.

3. An anceint Hindu geographical work.

4. Vol. I, p. 198.

Rivers.—The rivers of India are said to come either from the cold mountains in the north or from the eastern mountains. Al-Bîrûnî devotes considerable space in discussing the rivers of India. Their sources and courses are mentioned in detail[1] and mention is also made of various Hindu sources from which he had gathered information regarding their names and areas traversed. First, he mentions a large number of rivers rising in the various knots as mentioned in the Vayu-Purana. They include such names as Godavari, Bhimarathi (Bhima), Krishna (Kistna), Tungabhadra, Kaveri, Sona (Son), Narmada (Nerbudda), Tapi (Tapti) Durga, Nanda, etc. After this another table is given with names of many more rivers such as Sarayu (Sarju), Gomati, Kansiki (Kosi) Gandaki (Gandak) and Karatoya. The river Sindh (Indus) rises in the mountains of Unang in the territory of the Turks, which can be reached *via* Kashmir and Gilgit. He also calls it the river Vaihand. The river Biyatta, known as Jailam (Jhelum) from the city of this name on its western banks and the river Candarâha (Chenab) join each other nearly 50 miles above Jahravar and pass along west of Multan. The river Biyah (Bias) flows east of Multan and afterwards joins the Biyatta and Candarâha. The Ivara (Ravi) is joined by the Kaj which rises in Nagarkot in the mountains of Bhatul. And thereupon flows the fifth river of the Punjab Shatladar (Sutlej).

He goes on to say that after these five rivers have joined below Multan at a place called Pancanada (Panchanad), *i.e.*, the meeting-place of five rivers, they

1. See Vol. I, Chap. XXV.

form an enormous water-course. In flood time it swells to such a degree as to cover a spate nearly 10 'farsakhs' —about 37 miles (obviously an exaggeration) and to rise above the trees of the plains, so that afterwards the rubbish carried by the floods is found in their highest branches like bird's nests. Further, it is added, that the Muslims called the river, after it had passed the Sindhi city Aror, as a united stream, the river of Mihrân. And that flowing straight on it became broader and broader, gaining in purity of water, enclosing in its course places like islands, until it reached Almanṣûrah situated between several of its arms and flowed into the ocean at two places near the city of Lohârânî (near Karachi) and more eastwards in the province of Kach at a place called Sindhu-Sagara (Sind-Sagar).[1]

The river Sarasti (Saraswati) falls into the sea at the distance of a bowshot east of Somnath. In connection with the Ganges and its numerous tributaries Al-Bîrûnî mentions the Hindu belief that originally the river flowed in Paradise and quoting the 'Matsaya Purana,' the writer goes on to say, 'after the Ganges had settled on earth it divided itself into seven arms, the middle of which is the main stream known as the Ganges.'[2] The river Jaun (Jamna) joins the Ganges below Kanoj, which lies west of it. The united stream falls into the great ocean near Ganga-Sagara. In another place[3] it is said that at the junction of the two rivers, Yamuna (Jamna) and Ganga (Ganges) there is a great tree called Prayaga, a tree of the species 'Vata' (?)

1. Vol. I, p. 260.
2. *Ibid.*, p. 261.
3. Vol. II, p. 170.

Between the mouths of Sarasti and the Ganges is mentioned the mouth of the river Narmada, which descends from the eastern mountains, takes its course in a south-western direction and falls into the sea near the town of Bahroj (Broach) nearly 60 'yojana' (nearly 480 miles)[1] east of Somnath.

Climate and Seasons.—Speaking of the seasons,[2] he says, that uneducated people use two divisions or year-halves, because the matter of the two solstices is clear to them from the observation of their senses. Further, the ecliptic is divided into two halves, according to its declination from the equator and this division was a more scientific one, less known to the people at large than the former, because according to the writer, it rested on calculation. Each half was called 'Kula'. That which had northern declination was called 'Uttra-Kula' and the one with the southern declination was 'Daksha-Kula'. By both these divisions the ecliptic was divided into four parts, and the period during which the sun traverses them were called the seasons of the year—spring, summer, autumn and winter. However, Al-Birûnî adds that the Hindus did not divide the year into four, but six parts and called these 'ritu', each 'ritu' comprehended two solar months. In the regions of Somnath people divided the year into three parts, each consisting of four months, the first being 'Varshakal' (rainy season) beginning with the month 'Ashadha' (Ashar, *i.e.*, June-July) the second 'Sitakala'

1. According to Al-Birūni one 'yojana' was equal to 8 Arabic miles or = 32,000 yards and one 'Kroh' = ⅛ 'yojana,' (Vol. I, p. 167).

2. Vol., I. p. 357.

(winter) and the third 'Ushnakala' (Grishma, *i.e.*, summer).

Following months are mentioned: Chaitra, Vaishakha, Jyastha, Ashadha, Sravana, Bhadrapada, Asvayuja, Karttika, Margashirsha, Pausha, Magha, and Phalgun.

Rainfall.—With regard to the peculiarities of rainfall of India[1] and the apparent eccentricities of the monsoon a characteristic description is provided.

'India has the tropical rains in summer, the priod being called "Varshakala." These rains are more copious and last the longer the more northward the situation of a province of India and the less it is intersected by ranges of mountains.[2] The people of Multan used to tell me that they have no "Varshakala," but the more northern provinces nearer the mountains have the "Varshakala." In Bhatal and Indravedi (Antervedi—the old name of the Lower Doab of the Ganges and Jamna, extending roughly from Etawah to Allahabad) it begins with the month of Ashadha (June-July) and it rains continually for four months as though water-buckets were poured out. In provinces still tarther northward, round the mountains of Kashmîr, up to the peak of Judari between Dunpur and Barshawar, copious rainfalls during the two and a half months beginning with the month of Sravana. However, on the other side of the peak there is no rainfall for the clouds in the north are very heavy and do not rise much above the surface, when they

1. Vol. I, p. 211.

2. A very keen observation—Actually in the north there is a diminution of rainfall from the monsoon as we proceed westward and southward (away from the Himalayas). The reference to the intersection of mountain ranges conveys the idea that Al-Birūni understood the effect of a 'rain shadow.'

reach the mountains, they strike against them and the clouds are passed like olives or grapes, in consequence of which the rain pours down and the clouds never pass beyond the mountains. Therefore Kashmir has no "Varshakala", but continual snowfall during two and a half months, beginning with Magha (January-February) and shortly after the middle of Chaitra (March-April) continual rains set in for a few days, melting the snow and clearing the earth. This rule seldom has an exception; however, a certain amount of extraordinary meteorological occurrences is peculiar to every province of India.'

Animals.—References to the animals of the country are very brief. Facts and hearsay are found curiously mixed up in the accounts provided and the subject is introduced as a mere digression.[1] First he describes an animal named 'Sharava', living in the plains of Kunkan (Konkan)—called 'Danak.' This creature is said to have been bigger than a 'gandar' (rhinoceros) and a terror to other animals. Of the 'gandar' itself it is said that it existed in large numbers in India, more particularly near about the Ganges. A description of the animal is given and it is added that the author witnessed how an elephant coming across a young 'gandar' was attacked by it. The animal wounded the forefoot of the elephant with its horn and threw it down on its face.

Then he says that there were crocodiles in the rivers of India as in the Nile, a fact which led the simple Al-Jâhiz[2] in his ignorance of the courses of the rivers

1. Vol. I, pp. 203-5.

2. Was one of the leading intellectuals and rationalist of Basrah in the middle of the ninth century A. D. One of his most famous compilations was a '*Book of Animals.*' He was also an anthropologist of repute.

and the shape and form of the ocean to think that the river of Mihrân (Indus) was a branch of the Nile. Besides there were other marvellous animals in the rivers of India of the crocodile tribe, 'Makara', curious kinds of fishes and an animal like a leather-bag which approaches the ships and plays in swimming. It is called 'burlu' (porpoise). In the rivers of Southern India there was an animal called by various names 'graha', 'jalatantu', and 'tendua'.

Communications and Itineraries.—Early in eleventh century India had not many well-developed lines of communications. The routes and their prevalent use for normal traffic was largely determined by considerations of geography (relief, climate and vegetation, etc.) military needs and pilgrimages. Al-Bîrûnî came to India at a very eventful period in her history when the main tide of the series of Muslim invasions under Sulṭân Maḥmûd had just subsided. These invasions had largely followed directions determined by the politico-geographical considerations. Therefore, in addition to the already frequented routes many new itineraries had come into being. In this connection the problem of reckoning distances is an interesting one. Al-Bîrûnî gives distances in 'farsakhs' though regarding the exact measure of which he does not give accurate information. After a comparative study of his reference to the Hindu 'yojana' and the Arabic miles, Sachau has established the relationship that one 'farsakh' is equal to about three miles.

Al-Bîrûnî did not consider the Hindu methods of reckoning distances accurate and suggested that it was

with the greatest exertion and caution that the statements of Hindu writers could be corrected. But keeping an open mind on the problem, he adds, 'However, we could not make up our mind to suppress that which we know on account of that which we do not know, we ask the readers' pardon where there is anything wrong . . . .'

Sixteen itineraries are given which seem to have been communicated to him by the military and civil officers of the Sulṭan who had marched on some of these roads with huge armies, *e.g.*, to Kanoj and to Somnath. In addition, the information was also probably derived from merchants, sailors, pilgrims and travellers both Hindu and Muslim. The starting points of these itineraries were Kanoj, Mahura (Muttra), Anhilwara (Pattan), Dhar in Malwa, Bari (the temporary Hindu capital east of Kanoj), and Bazana.

These itineraries were: (1) From Kanoj to Allahabad and thence towards the eastern coast of India as far as Kanci (Conjeveram) and farther south. This route first passed through the Jamna-Ganges Doab touching at Jajjamau (Jhajamau), Abhapuri, Kuraha, Brahmashil and the tree of Prayaga (Allahabad). Thence it proceeded to Uwaryahar (Orissa) and Urdabishan (?) on the coast and onwards to Kanji (Conjeveram and Kunk). (2) From Kanoj or Bari to Banarasi (Benares) and thence to the mouth of the Ganges. The places mentioned along the route are Ajodaha (Ayodhya), Banarasi (Benares), Sharwar, Pataliputra (Patna), Mungiri (Monghyr), Janpa Dungumpur, and Gangasayara (Ganga-Sagar) where the Ganges flows into the sea. (3) From Kanoj eastward as far as Kamrup and northward to Nepal and the Tibetan

frontier which passed through Bari, Dugum and Bihat, after which the country to the right is mentioned as Tilwat (Tirhut) where Mongolian flat-nosed features are observed and then stretch the mountains of Kamru (Kamrup). Opposite Tirhut on the left of the road was the country of Nepal. (4) From Kanoj southward, as far as Benavasi on the south coast. This route touched at Gwalior and Kalanjar and passed through the realm of Kajuraha and Mannakara (Balhara). (5) From Kanoj to Bazana or Narayan,[1] the then capital of Gujerat. (6) From Muttra to Dhar, the capital of Malwa. Ujjain lay along this route. (7) From Bazana to Dhar and Ujjain. From Bazana one route led to Mewar passing through the capital Jattaraur (Chittor) and onwards to Dhar. (8) From Dhar towards the Godavari, the road went to Bhumihara, Kand, Namuvur (on the banks of the Nerbudda), Alispur (Ellichpur) and reached Mandagir on the banks of the Gadavar (Godavari). (9) From Dhar to Tana (Thana) on the Indian Ocean. The route lay across Mahratta-Desh (Maharashtra) and the province of Kunkan to reach Thana its capital. (10) From Bazana to Somnath on the south coast of Kathiawar. On the way lay Anhilwara (Pattan). (11) From Pattan to Thana, on the west coast north of Bombay. This route passed through Bhiroj (Broach). (12) From Bazana *via* Bhati to Loharani at the mouth of the Indus. The towns on this road were Bhati Multan, Aror, Almansurah, and Loharani (near modern Karachi). (13) From Kanoj to Kashmir, marching north-west, one went to Shirsharaha, Thaneshar (Thaneshwar), Jalan-

1. Identified with Narayanpur in the neighbourhood of modern Jaipur. See Elliot, Vol. I, pp. 393-95.

dhar. (14) From Kanoj to Ghazni, through Diyaman, Kuti, Anar, Mirat (Meerut), Panipat. Between Meerut and Panipat flows the Jaun (Jamna) onwards come Lauhawur (Lahore) east of the river Irawar (Ravi) then river Candahara (Chenab) the river Jailam (Jhelum), Purshawar (Peshawar), Dunpur, Kabul and finally Ghazna (Ghazni). (15) From Babrahan to Addishtan, the capital of Kashmîr. (16) From Tiz in Makran, along the coast as far as Setubandha, opposite Ceylon. This route has already been described in connection with India's frontiers.

On the whole, Al-Bîrûnî's sense of distance does not seem to be perfect. In numerous instances, he hopelessly underestimates distances Particularly with regard to Eastern and Southern India his ideas of mileage are very defective. But considering the then greater effectiveness of geographical barriers and the slow means of communication, his knowledge was remarkable indeed.

Commerce, and Merchandise and Towns, etc.

Al-Bîrûnî speaks of numerous Indian towns and cities, explains their religious importance, refers to their fame as seats of learning and in many cases describes their role as centres of communications and places of commercial transaction. However, a systematic reference to the trade and commercial activities and the movement of merchandise is not found. Only here and there he speaks about the importance of certain ports, *i.e.*, Somnath, Lohârânî, etc. in relation to their importance as outlets for Indian exports and gates of exit for

traffic to East Africa or the East Indies and China. For example, he says that Somnath was a harbour of seafaring people and a station for those who went to and fro between Sufâlah in the country of Zanj (E. Africa) and China.[1] Al-Bîrûnî mentions the clove trade with Ceylon and says that 'the clove is called "lavang", because it is imported from a country called langa' (Lanka-Ceylon). According to the uniform report of all sailors, the ships which are sent to this country land their cargo in boats, *viz.*, ancient western "denars" and various kinds of merchandise, striped Indian cloth, salt and other usual articles of trade. These wares are deposited on the shore on leather sheets, each of which is marked with the name of its owner. Thereupon the merchants retire to their ships. On the following day they find the sheets covered with cloves by way of payment, little or much as the natives happen to own.[2] This throws light on the usual method of barter in trade resorted to in India's trade with the neighbouring lands. He also refers to the dwindling pearl fisheries of the Palk Strait when he says that in former times there were pearl-banks in the bay of Sarandib (Palk Strait) but that they had been abandoned in his times, and that their place was taken by Sufâlah pearls.[3]

Benares.—Benares is mentioned as a great centre of Hindu learning where a large number of savants had fled before the onrush of the Muslim conquests. It was also venerated as a religious centre and for the expounding of Hindu law and was a noted place of pilgrimage.

1. Sachau : *Al-Birūni's India*, Vol, II p. 104.
2. *Ibid.*, Vol. I, p. 309.
3. *Ibid.*, Vol. I, p. 211.

Through it passed the important routes to the lower Ganges area and Bihar, North Bengal and Assam.

Kanoj.—Kanoj is mentioned as one of the most notable places in India, for the obvious reason that it represented the nucleus of the Indian political power on the eve of the memorable invasions of Sulṭân Maḥmûd. According to the savant Balabhadra its position was 26° 35′ latitude. Al-Bîrûnî points out that the river Jaun (Jamna) joined the river Ganges below Kanoj, which lay west of it. The country all around the great city was called Aryavarta (also called Madhyadesa—the middle of the realms). He continues, 'It is the middle or centre from geographical point of view in so far as it lies half-way between the hot and the cold provinces and also between the eastern and western frontiers of India. But it is a political centre, too, because in former times it was the residence of their (Hindus') most famous heroes and kings[1].' But at the time he wrote it was mostly in ruins and desolate, since the capital was transferred to the city of Bari, east of the Ganges (certainly for purpose of better defence). It was the nodal centre for many itineraries emanating in various directions. Kanoj formed at that time part of the realm of the Pala Kings of Bengal who ruled from Mongir (Monghyr).

Mahura (Muttra) is mentioned as the city of Vasudeva lying east of the river Jaun (Jamna), nearly 28 farsakh[2] from Kanoj. It was a holy place crowded with Brahmans and was venerated because Vasudeva

1. Vol., I, p. 198.
2. One farsakh = about three miles.

was born and brought up in a place in the neighbourhood called Nandagola.

Mulasthana.—Almâmûra (Multan) was a noteworthy city at the time. The five rivers of the Punjab united below Multan at a place called Pancanada (Panchanad). Its latitude is given as 29° 40′. Al-Bîrûnî had himself resided here for some time. He has mentioned the small amount of rain from the monsoon by saying that there was no varshakala (rainy season). Before the Muslim conquest it was also one of the holy places having a sacred temple and a pond. The Hindus continued to have a festival which they called 'Sambapurayvrata' celebrated in honour of the sun.

In connection with the first inroads of the Muslims into India he adds, 'Ibn al-Qâsim entered Sindh from the side of Sijistan and conquered the cities of Bahmanwa and Mulasthana, the former of which he called Almanṣûra and the latter Almâmûra. He entered India proper and penetrated even as far as Kanauj, marched through the country of Gandhara and on his way back, through the confines of Kashmir, sometimes fighting sword in hand, sometimes gaining his ends by treaties, leaving to the peoples their ancient belief, except in the case of those who wanted to become Muslims. All these events planted a deeply rooted hatred in their hearts.'[1]

According to Utpala, a native of Kashmir, quoted by Al-Bîrûnî, 'Multan was originally called Kasyapapura then Hamsapura, then Bagapura, then Sambhapura and then Mulasthana, *i.e.* original place, for "mula" means root, origin and "tana" (Sthana?) means place.'[2]

1. Vol. I, p. 21.
2. Sachau: *Al-Bîrûnî's India*, Vol. I, p. 293.

Lāhur (Lahore) is mentioned as a strong fortress town with a latitude of 34° 10′. The distance from Lahore to the capital of Kashmîr is given as 56 miles (obviously an underestimate), half the way being plain and the rest rugged country.[1]

Lohārānī (near modern Karachi) was situated at the mouth of the river Sindh (Indus) another arm of which joined the sea more eastward in the province of Katch at a place called Sindhu-Sagara. In 'Canon Masudicus' (Al-Qânûn al-Mas'ûdî)[2] its latitude is given as 24° 40′.

Purshāwar (Peshawar) is mentioned as a notable town of Gandhara with latitude 34° 44′ and had Buddhist monasteries.

Somnath was said to have a sea-coast situation and therefore a nest of pirates. 'They are thus called because they commit robberies on sea in ships called "bira". The river Sarsati (Saraswati) joined the sea at a distance of a bowshot east of Somnath.' At this period, it seems, it was a busy port sharing in the commerce and traffic with East Africa, Ceylon and China. It was a place greatly venerated by the Hindus and its famous temple was a repository of enormous wealth. That was indeed the most powerful factor in attracting the attention of Sulṭân Maḥmûd. Al-Bîrûnî gives the year of its destruction as 416 A.H. He adds that here was erected the 'linga' of Mahadeva. 'Soma' meaning moon and 'natha' meaning master, so that the word Somanatha meant master of the moon.[3]

1. Sachau: *Al-Biruni's India*, Vol. I, p. 317
2. Sachau, *Annotations*, p. 317.
3. Vol. II, p. 103.

It is in connection with the description of Somanatha that Al-Bîrûnî describes the phenomena of the ebb and the flow of the tides.

Ujain.—Uzain (Ujjain) was situated in Malwa; its latitude is given as 24° or, according to Brahmagupta, $16\frac{1}{4}$°. To the astronomers and the geographers its importance lay in the fact that to the Hindus it represented 0° longitude. Al-Bîrûnî refers to a common mistake among Muslim astronomers and geographers to give Ujjain a sea-coast position. He says that in reality it was a hundred 'yojana' from the sea. He says that the Hindu prime meridian passed through in a straight line from Lanka (Ceylon) to Meru (in Himalayas, beyond India) and that other positions on it were Ujjain, fortress of Rohitaka in Multan District, Kurukshetra in the plain of Taneshar (Thaneshwar), Mathura (Muttra), etc.[1] Ujjain was an important centre of communications.

Kashmîr.—References to the various geographical aspects of Kashmîr are many. It is an area of high mountain ranges and provided a sanctuary to Hindu scientists and other refugees escaping from the Muslim-dominated regions to the south. Al-Bîrûnî's short description of Kashmîr brings out clearly the various aspects of its physical and human geography and the interrelation between them i.e. its mountainous nature, deep narrow river valleys, difficulty of communications, easier defence against foreign intrusion and close settlement in the vale of Kashmîr, etc. His own words explain it best, 'The inhabitants of Kashmîr are pedes-

1. Vol. II, pp. 206-7.

trians, they have no riding animals nor elephants. The noble among them ride in palanquins called "katt" carried on the shoulders of men. They are particularly anxious about the natural strength of their country, and therefore always take much care to keep a strong hold upon the entrances and roads leading into it. In consequence, it is very difficult to have any commerce with them .... The best known entrance to Kashmîr is from the town Barbahan, half-way between the rivers Sindh (Indus) and Jailam (Jhelum). Thence to the bridge over the river ... thence you reach in five days the beginning of the ravine whence the Jailam comes..[1] thence leaving the ravine you enter the plain and reach in two more days Addishtan, the capital of Kashmîr, *via* Baramula. The main city of Kashmîr covers a space of four farsakh (about 12 miles), being built along both banks of the river Jailam, which are connected with each other by bridge and ferry-boats. The Jailam rises in the mountains of Haramakot, where the snow never melts nor disappears. Behind them there is Mahâchîn, *i.e.* Great China. When the Jailam has left the mountains, and has flowed two days' journey, it passes through Addishtan (Srinagar). Four farsakh farther on it enters a swamp of three square farsakh. The people have their plantations on the borders of this swamp and on such parts of it as they manage to reclaim.[2]

The rainfall of Kashmîr is said to be heavy and commenced with the month of Sravana, lasting two and

1. More or less the modern Rawalpindi route through the valley of the Jhelum into Kashmir.

2. Vol. II, pp. 206-7.

a half months. As a result the rivers were in spate and timber would be seen floating down the Jhelum.'

Naipal (*Nepal*).—There is also a brief and interesting note on the remote and isolated mountainous area of Nepal, depicting some of its geographical peculiarities. In Al-Bîrûnî's words, 'Opposite Tilwat (Tirhut) the country to the left (north) is the realm of Naipal. A man who had travelled in those countries gave me the following report—when in Tanwat he left the easterly direction—turned to the left (north). He marched to Naipal, a distance of 20 farsakh, most of which was ascending country. From Naipal he came to Bhoteswar (probably Al-Bîrûnî means Bhutan) in thirty days, a distance of nearly 80 farsakh, in which there is more ascending than descending country. And there is a water which is crossed several times on bridges consisting of planks tied with cords to two canes, which stretch from rock to rock and are fastened to milestones constructed on either side. People carry burdens on their shoulders over such a bridge, whilst below at a depth of 100 yards, the water foams as white snow, threatening to shatter the rocks. On the other side of the bridges the burdens are transported on the back of goats .... Bhoteshar is the first frontier of Tibet. There the language changes as well as the dresses and the anthropological character of the people. Thence the distance to the top of the highest peak is 20 farsakh. From the height of this mountain, India appears as a black expanse below the mist, the mountains lying below this peak like small hills and Tibet and China appear as red. The descent towards Tibet and China is less than one farsakh.'

Conclusion

As has already been mentioned, Al-Bîrûnî did not write 'Kitâbul Hind' primarily as a geography of India. His work was unique in this respect that he wrote as an Indianist who touched upon a variety of subjects (religion, philosophy, literature, customs, laws, astrology, astronomy, chronology and geography). Certainly, it was not an easy task for a foreigner, howsoever learned and well-informed, and Al-Bîrûnî makes an honest admission in this respect when he says that 'I found it very hard to work into the subjects, although I have a great liking for them, in which respect I stand quite alone in my time.'[1] In addition, his entire approach was academic and free of prejudices of any kind, religious or cultural, and Sachau rightly remarks that the work of Al-Bîrûnî is unique in Muslim literature, as an earnest attempt to study an idolatrous world of thought, not proceeding from the intention of attacking and refuting it, but uniformly showing the desire to be just and impartial, even when the opponent's views are declared to be inadmissible.

So much about Al-Bîrûnî's observations on India in general. From the point of view of geographical interest, he was a writer who quite often touched upon mineralogical, cosmographical and geographical subjects. In his work on *India*, in a number of chapters[2] he dilates upon geography, cosmography and astronomy, but outside such sections there are numerous references to the geography of the country, *i.e.*, physical aspects, trade

1. Vol. I, p. 24.
2. Chaps. XVIII to XXXI.

and commerce, towns and cities, routes and communications, etc. Therefore, in the preceding paragraphs an attempt has been made to collect all those references and put them in a systematic form.

As to the merit of Al-Bîrûnî's geographical writings on India, it may be observed that, on the whole, he reveals himself as a very keen observer. His remarks on geological, meteorological and climatological aspects are sound, penetrating and thought-provoking. In astronomical and cosmographical matters he examines numerous Hindu sources and is usually severe in his criticism of them, at times verging on exaggeration. But his extent of information, and marshalling of relevant material, is truly amazing. Although his sense of distance is at fault at times, quite often an underestimate. All in all, Al-Bîrûnî gives a better idea of the inhabitable world than many of his predecessors: he believed in the southern extension of the African continent and the navigability of the ocean in the south. He clearly understood the phenomena of tides and explained how the increase and decrease in ebb and flow develop periodically and parallel with the moon's phases and he added that such things were known to the people living near the seashores and he refers to this in connection with the situation of Somnath. According to him the educated Hindus used to determine the daily ebb and flow of the tides by the rising and the setting of the moon, the monthly phases by the increase and the waning of the moon; but was of the opinion that they did not know the physical causes of both phenomena. On the mathematical and the astronomical side he

discussed the antipodes and the roundity of the earth, the determination of its movements, and gave the latitudes and longitudes of numerous places in India as well as outside of it.[1]

Finally, we usually find Al-Bîrûnî taking due notice of the operation of the geographical factor in human affairs and attempting to establish an inter-relationship, howsoever crude and imperfect. That alone entitles him to a high place among the outstanding mediæval geographers.

1. *Supra* Chaps. II and III.

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